Alaska Marine Mammal Stock Assessments, ~~2014~~2015

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PREFACE

On 30 April 1994, Public Law 103-238 was enacted allowing significant changes to provisions within the Marine Mammal Protection Act (MMPA). Interactions between marine mammals and commercial fisheries are addressed under three new sections. This new regime replaced the interim exemption that has regulated fisheries-related incidental takes since 1988. Section 117, Stock Assessments, required the establishment of three regional scientific review groups to advise and report on the status of marine mammal stocks within Alaska waters, along the Pacific Coast (including Hawaii), and the Atlantic Coast (including the Gulf of Mexico). This report provides information on the marine mammal stocks of Alaska under the jurisdiction of the National Marine Fisheries Service.

Each stock assessment includes, when available, a description of the stock's geographic range, a minimum population estimate, current population trends, current and maximum net productivity rates, optimum sustainable population levels and allowable removal levels, and estimates of annual human-caused mortality and serious injury through interactions with commercial fisheries and subsistence hunters. These data will be used to evaluate the progress of each fishery towards achieving the MMPA's goal of zero fishery-related mortality and serious injury of marine mammals.

The Stock Assessment Reports should be considered working documents, as they are updated as new information becomes available. The Alaska Stock Assessment Reports were originally developed in 1995 (Small and DeMaster 1995). Revisions have been published for the following years: 1996 (Hill et al. 1997), 1998 (Hill and DeMaster 1998), 1999 (Hill and DeMaster 1999), 2000 (Ferrero et al. 2000), 2001 (Angliss et al. 2001), 2002 (Angliss and Lodge 2002), 2003 (Angliss and Lodge 2004), 2005 (Angliss and Outlaw 2005), 2006 (Angliss and Outlaw 2007), 2007 (Angliss and Outlaw 2008), 2008 (Angliss and Allen 2009), 2009 (Allen and Angliss 2010), 2010 (Allen and Angliss 2011), 2011 (Allen and Angliss 2012), 2012 (Allen and Angliss 2013), ~~and~~ 2013 (Allen and Angliss 2014), and 2014 (Allen and Angliss 2015). Each Stock Assessment Report is designed to stand alone and is updated as new information becomes available. The MMPA requires ~~s~~Stock ~~a~~Assessment ~~r~~Reports to be reviewed annually for stocks designated as strategic, annually for stocks where there is significant new information available, and at least once every 3 years for all other stocks. New information for all strategic stocks (Steller sea lions, northern fur seals, bearded seals, ringed seals, Cook Inlet beluga whales, AT1 transient killer whales, harbor porpoise~~s~~, sperm whales, humpback whales, fin whales, North Pacific right whales, and bowhead whales) was reviewed in ~~2013-2014~~2014-2015. This review, and a review of other stocks, led to the revision of the following stock assessments for the ~~2014~~2015 document: Steller sea lions (~~w~~Western ~~and eastern~~ U.S. stock~~s~~), northern fur seals, ~~spotted seal,~~ bearded seals, ringed seals, ribbon seals, beluga whales (~~Beaufort Sea, eastern Chukchi Sea, eastern Bering Sea, Bristol Bay, and~~ Cook Inlet stock~~s~~), AT1 T~~t~~ransient killer whales, harbor porpoise~~s~~ (~~s~~Southeast Alaska, Gulf of Alaska, and Bering Sea stocks), sperm whales, ~~w~~Western and ~~c~~Central North Pacific stocks of humpback whales, fin whales, ~~e~~Eastern North Pacific right whales, and bowhead whales. The ~~s~~Stock ~~a~~Assessment ~~r~~Reports for all stocks, however, are included in the~~is~~ final Stock Assessment Report document to provide a complete reference. Those sections of each ~~s~~Stock ~~a~~Assessment ~~r~~Report containing significant changes are listed in Appendix Table 1. The authors solicit any new information or comments which would improve future ~~s~~Stock ~~a~~Assessment ~~r~~Reports.

The U.S. Fish and Wildlife Service (USFWS) has management authority for polar bears, sea otters, and walrus. Copies of the stock assessments for these species are included in ~~this~~the final NMFS Stock Assessment Report for your convenience.

Ideas and comments from the Alaska Scientific Review Group (SRG) have significantly improved this document from its draft form. The authors wish to express their gratitude for the thorough reviews and helpful guidance provided by the Alaska Scientific Review Group members: Karl Haflinger, Lloyd Lowry (Chair from 2012 to present), Beth Mathews, Craig Matkin, Mike Miller, Grey Pendleton, Robert Small, Kate Stafford, Robert Suydam, David Tallmon, and Kate Wynne.

The information contained within the individual ~~s~~Stock ~~a~~Assessment ~~r~~Reports stems from a variety of sources. Where feasible, we have attempted to utilize only published material. When citing information contained in this document, authors are reminded to cite the original publications, when possible.

CONTENTS*

*Stock Assessment Reports and Appendices revised in 2015 are highlighted in gray.

Revised ~~10/09/2014~~9/8/2015

STELLER SEA LION (*Eumetopias jubatus*): Western U.S. Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands (Fig. 1). Large numbers of individuals disperse widely outside of the breeding season (late May-early July), probably to access seasonally important prey resources. This results in marked seasonal patterns of abundance in some parts of the range and potential for intermixing in foraging areas of animals that were born in different areas (Sease and York 2003). Despite the wide-ranging movements of juveniles and adult males in particular, exchange between rookeries by breeding adult females and males (other than between adjoining rookeries) is low, although males have a higher tendency to disperse than females (NMFS 1995, Trujillo et al. 2004, Hoffman et al. 2006).

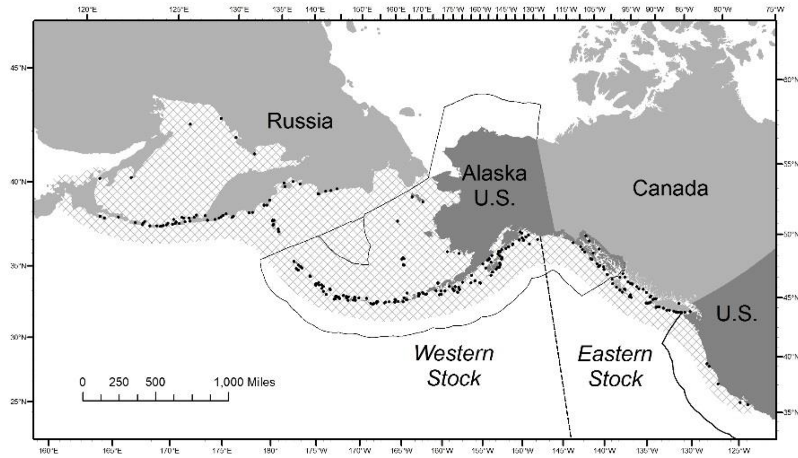

Figure 1. Generalized distribution (crosshatched area) of Steller sea lions in the North Pacific and major U.S. haulouts and rookeries (50 CFR 226.202, 27 August 1993), as well as active Asian and Canadian (British Columbia) haulouts and rookeries (points: Burkanov and Loughlin 2005; S. Majewski, Fisheries and Oceans Canada, pers.~~onal~~ comm.~~unication~~). Black dashed line (144°W) indicates stock boundary (Loughlin 1997) and solid black line delineates U.S. Exclusive Economic Zone.

Loughlin (1997) and Phillips et al. (2009) considered the following information when classifying stock structure based on the phylogeographic approach of Dizon et al. (1992): 1) Distributional data: geographic distribution continuous, yet a high degree of natal site fidelity and low (<10%) exchange rate of breeding animals ~~between~~among rookeries; 2) Population response data: substantial differences in population dynamics (York et al. 1996); 3) Phenotypic data: differences in size (males) and shape (females) of skulls ~~morphology~~ (Phillips et al. 2009); and 4) Genotypic data: substantial differences in mitochondrial DNA (Bickham et al. 1996). Based on this information, two separate stocks of Steller sea lions were recognized within U.S. waters: an ~~e~~Eastern U.S. stock, which includes animals born east of Cape Suckling, Alaska (144°W), and a ~~w~~Western U.S. stock, which includes animals born at and west of Cape Suckling (Loughlin 1997; Fig. 1). However, Jemison et al. (2013) summarized that there is regular movement of Steller sea lions from the western distinct population segment (DPS) (males and females equally) and eastern DPS (almost exclusively males) across the DPS boundary.

Steller sea lions that breed in Asia are considered part of the western stock. Whereas Steller sea lions seasonally inhabit coastal waters of Japan in the winter, breeding rookeries outside of the U.S. are currently only located in Russia (Burkanov and Loughlin 2005). Analyses of genetic data differ in their interpretation of separation between Asian and Alaskan sea lions. Based on analysis of mitochondrial DNA, Baker et al. (2005) found evidence of a genetic split between the Commander Islands (Russia) and Kamchatka that would include Commander Island sea lions within the ~~w~~Western U.S. stock and animals west of there in an Asian stock. However, Hoffman et al. (2006) did not support an Asian/western stock split based on their analysis of nuclear microsatellite markers indicating high rates of male gene flow. Berta and Churchill (2012) concluded that a putative Asian stock is "not substantiated by microsatellite data since the Asian stock groups with the western stock." All genetic analyses (Baker et al. 2005; Harlin-Cognato et al. 2006; Hoffman et al. 2006, 2009; O'Corry-Crowe et al. 2006) confirm a strong separation between western and eastern stocks, and there may be sufficient morphological differentiation to support elevating the two recognized stocks to subspecies (Phillips et al. 2009), although a recent review by Berta and Churchill (2012) characterized that status of these subspecies assignments as "tentative" and requiring further attention before their status can be determined. Recent work by Phillips et al. (2011) addressed the effect of climate change, in the form of glacial events, on the evolution of Steller sea lions and reported that the effective population size at the time of the event determines the impact of change on the population. The results suggested that during historic glacial periods, dispersal events were correlated with historically low effective population sizes, ~~while~~whereas range fragmentation type events were correlated with larger effective population sizes. This work again reinforced the stock delineation concept by noting that ancient population subdivision likely led to the sequestering of most mtDNA haplotypes as DPS, or subspecies-specific (Phillips et al. 2011).

In 1998, a single Steller sea lion pup was observed on Graves Rock in northern Southeast Alaska~~,~~ and, by 2013, pup counts had increased to 551 (DeMaster 2014). Mitochondrial and microsatellite analysis of pup tissue samples collected in 2002 revealed that approximately 70% of the pups had mtDNA haplotypes that were consistent with those found in the western stock (Gelatt et al. 2007). Similarly, a rookery to the south on the White Sisters Islands, where pups were first noted in 1990, was also sampled in 2002 and approximately 45% of those pups had western stock haplotypes. Collectively, this information demonstrates that these two most recently established rookeries in northern ~~s~~Southeast Alaska have been partially to predominately established by western stock females. While ~~M~~movements of animals marked as pups in both stocks support these genetic results (Jemison et al. 2013) ~~Overall, however~~, overall the observations of marked sea lion movements corroborate the extensive genetics research findings for a strong separation between the two currently recognized stocks. ~~Although~~O'Corry-Crowe et al. (2014) concluded that the results of their study of the genetic characteristics of pups born on these new rookeries "demonstrates that resource limitation may trigger an exodus of breeding animals from declining populations, with substantial impacts on distribution and patterns of genetic variation. It also revealed that this event is rare because colonists dispersed across an evolutionary boundary, suggesting that the causative factors behind recent declines are unusual or of larger magnitude than normally occur." Thus, although recent colonization events in the ~~far~~ northern part of the eastern DPS indicate movement of western sea lions into this area, the mixed part of the range remains small (Jemison et al. 2013), and the overall discreteness of the eastern from the western stock remains distinct. Hybridization among subspecies and species along a contact zone such as now occurs near the stock boundary is not unexpected as the ability to interbreed is a primitive condition whereas reproductive isolation would be derived. In fact, as stated by NMFS and FWS in a 1996 response to a previous comment regarding stock discreteness policy (61 FR 47222), "*The Services do not consider it appropriate to require absolute reproductive isolation as a prerequisite to recognizing a distinct population segment*" or stock. The fundamental concept overlying this distinctiveness is the collection of morphological, ecological and behavioral, and genetic evidence for stock differences initially described by Bickham et al. (1996) and Loughlin (1997)~~,~~ and supported by Baker et al. (2005), Harlin-Cognato et al. (2006), Hoffman et al. (2006, 2009), O'Corry-Crowe et al. (2006), and Phillips et al. (2009, 2011).

POPULATION SIZE

~~The most recent comprehensive aerial photographic and land-based surveys of western Steller sea lions in Alaska were conducted in 2008-2013 (Fritz et al. 2013, DeMaster 2014). An estimate of the total population size of western Steller sea lions in Alaska can be obtained by multiplying the best estimate of total pup production by 4.5 (Calkins and Pitcher 1982). Total pup production in Alaska in 2013 was estimated to be 12,316 (95% credible interval: 11,741-12,926) using a Bayesian hierarchical model, agTrend (Johnson and Fritz 2014), and 2013 survey results (DeMaster 2014). When multiplied by 4.5, this yields a total population estimate of 55,422 (95% credible interval: 52,834-58,167). This is not a minimum abundance estimate since it is an extrapolated total population size from pup counts based on survival and fecundity estimates for an assumed stable, mid-1970s central Gulf of Alaska population (Fig. 2; Calkins and Pitcher 1982) and may not be appropriate for use in estimating the abundance of the Alaskan western stock as a whole given the considerable regional variation in current trends: populations east of Samalga Pass are generally increasing, while those to the west are decreasing (Fig. 2; Fritz et al. 2013, DeMaster 2014). Vital rates of Steller sea lions in the central Gulf of Alaska may have changed considerably since the mid-1970s as the population declined through the 1980s and 1990s and has been slowly increasing in the 2000s (York 1994, Holmes and York 2003, Fay and Punt 2006, Pendleton et al. 2006, Winship and Trites 2006, Holmes et al. 2007, DeMaster 2014). For the increasing eastern stock of Steller sea lion, Pitcher et al. (2007) showed that the multiplier could range between 4.2 and 5.2 depending on the combination of changes to survival and natality.~~

~~Methods used to survey Steller sea lions in Russia differ from those used in Alaska, with less use of aerial photography and more use of skiff surveys and cliff counts for non-pups and ground counts for pups. The most recent counts of non-pup Steller sea lions in Russia were conducted in 2007-2011, and totaled ~12,700 (V. Burkanov, NMFS Alaska Fisheries Science Center, NMML, 7600 Sand Point Way NE, Seattle, WA 98115, pers. comm.). The most recent estimate of pup production in Russia is available from counts conducted in 2011 and 2012, which totaled 6,021 pups and yields a total population abundance estimate of 27,100 Steller sea lions using the 4.5 multiplier.~~

~~An estimate of the abundance of the entire (U.S. and Russia) western stock of Steller sea lions (pups and non-pups) can be made by adding the most recent estimates of U.S. and Russian pup production, and multiplying by 4.5 (12,316 + 6,021 = 18,337 pups × 4.5), which yields 82,516.~~

The western stock of Steller sea lions decreased from an estimated 220,000 to 265,000 animals in the late 1970s to less than 50,000 in 2000 (Loughlin et al. 1984, Loughlin and York 2000, Burkanov and Loughlin 2005). Since 2000, the abundance of the western stock has increased, but there has been considerable regional variation in trend (Sease and Gudmundson 2002, Burkanov and Loughlin 2005, Fritz et al. 2013). The most recent comprehensive aerial photographic and land-based surveys of western Steller sea lions in Alaska were conducted in 2013-2014 (DeMaster 2014, Fritz et al. 2015). Western Steller sea lion pup and non-pup counts in Alaska in 2014 were estimated to be 12,189 (90% credible interval: 11,318-13,064) and 37,308 (34,373-40,314), respectively, using agTrend (Johnson and Fritz 2014) and 2013-2014 survey results (DeMaster 2014, Fritz et al. 2015). Demographic multipliers (e.g., pup production multiplied by 4.5) and proportions of each age-sex class that are hauled out during the day in the breeding season (when aerial surveys are conducted) have been proposed as methods to estimate total population size from pup and/or non-pup counts (Calkins and Pitcher 1982, Higgins et al. 1988, Milette and Trites 2003, Maniscalco et al. 2006). However, there are several factors which make using these methods problematic when applied to counts of western Steller sea lions in Alaska, including the lack of vital (survival and reproductive) rate information for the western and central Aleutian Islands, the large variability in abundance trends across the range (see Current Population Trend section below and Pitcher et al. 2007), and the large uncertainties related to reproductive status and foraging conditions that affect proportions hauled-out (see review in Holmes et al. 2007).

Methods used to survey Steller sea lions in Russia differ from those used in Alaska, with less use of aerial photography and more use of skiff surveys and cliff counts for non-pups and ground counts for pups. The most recent counts of non-pup Steller sea lions in Russia were conducted in 2007-2011 and totaled ~12,700 (V. Burkanov, NMFS, Alaska Fisheries Science Center, NMML, 7600 Sand Point Way NE, Seattle, WA 98115, pers. comm.). The most recent estimate of pup production in Russia is available from counts conducted in 2011 and 2012, which totaled 6,021 pups.

Minimum Population Estimate

Because of the uncertainty regarding the use of the pup multiplier to estimate N, we will use the best estimate of the total count of western Steller sea lions in Alaska as the minimum population estimate (N_{MIN}). The agTrend (Johnson and Fritz 2014) estimates (with ~~95~~90% credible intervals) of western Steller sea lion pup and non-pup counts in ~~2013~~2014 in Alaska are ~~12,316~~12,189 (~~11,741-12,926~~11,318-13,064) and ~~36,360~~37,308 (~~34,469-38,271~~34,373-40,314), respectively, which total ~~48,676~~49,497~~,~~ and will be used as the minimum population estimate (N_{MIN}) for the U.S. portion of the western stock of Steller sea lions (Wade and Angliss 1997). This is considered a minimum estimate because it has not been corrected to account for animals that were at sea during the surveys.

Current Population Trend

The first reported trend counts (sums of counts at consistently surveyed, large sites used to examine population trends) of Steller sea lions in Alaska were made in 1956-1960. Those counts indicated that there were at least 140,000 (no correction factor applied) sea lions in the Gulf of Alaska and Aleutian Islands (Merrick et al. 1987). Subsequent surveys indicated a major population decrease, first detected in the eastern Aleutian Islands in the mid-1970s (Braham et al. 1980). Counts from 1976 to 1979 totaled about 110,000 sea lions (no correction factor applied). The decline appears to have spread eastward to Kodiak Island during the late 1970s and early 1980s, and then westward to the central and western Aleutian Islands during the early and mid-1980s (Merrick et al. 1987, Byrd 1989). During the late 1980s, counts in Alaska overall declined at ~15% per year (NMFS 2008) which prompted the listing (in 1990) of the species as threatened range-wide under the Endangered Species Act (ESA). Continued declines in counts of western sea lions in Alaska in the 1990s (Sease et al. 2001) led NMFS to change the ESA listing status to endangered in 1997 (NMFS 2008). Surveys in Alaska in 2002, however, were the first to note an increase in counts, which suggested that the overall decline of western Steller sea lions stopped in 2000-2002 (Sease and Gudmundson 2002).

Johnson and Fritz (2014) developed agTrend to estimate regional and overall trends in counts of pups and non-pups in Alaska using data collected at all sites with ~~more than~~at least two non-zero counts, rather than relying solely on counts at "trend" sites (see also Fritz et al. 2013). Using agTrend with data collected through ~~2013~~2014, there is strong evidence that non-pup counts of western stock Steller sea lions in Alaska increased between 2000 and ~~2013~~2014 (Table 1; ~~DeMaster 2014~~Fritz et al. 2015). However, there are strong regional differences across the range in Alaska, with positive trends east of Samalga Pass (~170°W) and negative trends to the west (Table 1; Fig. 2).

Regional variation in trends in pup counts in 2000-~~2013~~2014 is similar to that of non-pups (Table 1). Overall, there is strong evidence that pup counts increased in the overall western stock in Alaska and that there is considerable regional variation west and east of Samalga Pass. West of Samalga Pass, pup counts are stable in the central Aleutian Islands but decreasing rapidly in the western Aleutian Islands. East of Samalga Pass, there is strong evidence that pup counts increased in ~~three~~each of the four regions~~, but were stable in the central Gulf of Alaska~~. Regional differences in pup trends cannot be explained by movement of pups during the breeding season. However, slower growth in pup counts in the central Gulf of Alaska than in the surrounding regions east of Samalga Pass could be due to movement of adult females out of the region (suggesting some level of permanent emigration) or poor local conditions, both of which suggest sea lions have responded to meso-scale (on the order of 100s of ~~kms~~kilometers) variability in their environment.

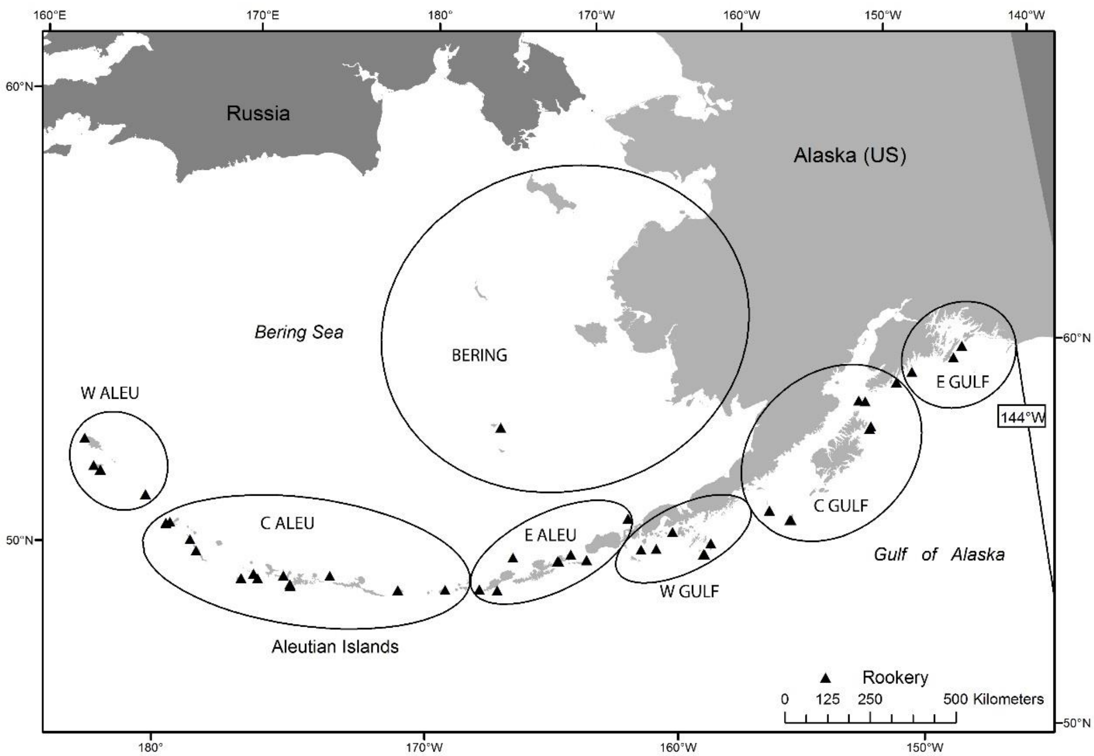

Figure 2. Regions of Alaska used for western Steller sea lion population trend estimation. E GULF, C GULF, and W GULF are eastern, central, and western Gulf of Alaska regions, respectively. E ALEU, C ALEU, and W ALEU are eastern, central, and western Aleutian Islands Islands regions, respectively.

Table 1. Trends (annual rates of change expressed as % y^{-1} with 95% credible interval) in counts of western Steller sea lion non-pups (adults and juveniles) and pups in Alaska, by region, for the period ~~2000-2012~~2000-2014 (Johnson and Fritz 2014, Fritz et al. 2015).

		Non-pups				Pups		
Region	**Latitude Range**	**Trend**	**-95%**	**+95%**		**Trend**	**-95%**	**+95%**
Western Stock in Alaska	144°W-172°E	2.17	1.54	2.76		1.76	1.16	2.31
E of Samalga Pass	144°-170°W	3.41	2.59	4.15		3.18	2.44	3.91
Eastern Gulf of Alaska	144°-150°W	5.22	2.48	8.06		4.44	2.36	6.42
Central Gulf of Alaska	150°-158°W	2.61	1.46	3.76		2.14	0.45	3.61
E-C Gulf of Alaska	144°-158°W	3.67	2.36	5.08		2.83	1.58	4.07
Western Gulf of Alaska	158°-163°W	4.09	2.77	5.33		3.27	1.86	4.72
Eastern Aleutian Islands	163°-170° W	2.3	0.98	3.67		3.55	2.43	4.62
W of Samalga Pass	170°W-172°E	-1.22	-2.02	-0.4		-1.66	-2.46	-0.86
Central Aleutian Islands	170°W-177°E	-0.27	-1.17	0.61		-0.64	-1.56	0.23
Western Aleutian Islands	172°-177°E	-7.10	-8.66	-5.57		-8.92	-10.14	-7.53

		~~Non-pups~~				~~Pups~~		
~~**Region**~~	~~**Latitude Range**~~	~~**Trend**~~	~~**-95%**~~	~~**+95%**~~		~~**Trend**~~	~~**-95%**~~	~~**+95%**~~
~~Western Stock in Alaska~~	~~144°W-172°E~~	~~1.67~~	~~1.01~~	~~2.38~~		~~1.45~~	~~0.69~~	~~2.22~~
~~E of Samalga Pass~~	~~144°-170°W~~	~~2.89~~	~~2.07~~	~~3.80~~		~~--~~	~~--~~	~~--~~
~~Eastern Gulf of Alaska~~	~~144°-150°W~~	~~4.51~~	~~1.63~~	~~7.58~~		~~3.97~~	~~1.31~~	~~6.50~~
~~Central Gulf of Alaska~~	~~150°-158°W~~	~~0.87~~	~~-0.34~~	~~2.18~~		~~1.48~~	~~-0.56~~	~~3.30~~
~~E-C Gulf of Alaska~~	~~144°-158°W~~	~~2.40~~	~~0.92~~	~~3.86~~		~~--~~	~~--~~	~~--~~
~~Western Gulf of Alaska~~	~~158°-163°W~~	~~4.01~~	~~2.49~~	~~5.42~~		~~3.03~~	~~1.06~~	~~5.20~~
~~Eastern Aleutian Islands~~	~~163°-170° W~~	~~2.39~~	~~0.92~~	~~3.94~~		~~3.30~~	~~1.76~~	~~4.83~~
~~W Gulf & E Aleutians~~	~~158°-170°W~~	~~3.22~~	~~2.19~~	~~4.25~~				
~~W of Samalga Pass~~	~~170°W-172°E~~	~~-1.53~~	~~-2.35~~	~~-0.66~~		~~--~~	~~--~~	~~--~~
~~Central Aleutian Islands~~	~~170°W-177°E~~	~~-0.56~~	~~-1.45~~	~~0.43~~		~~-0.46~~	~~-1.50~~	~~0.72~~
~~Western Aleutian Islands~~	~~172°-177°E~~	~~-7.23~~	~~-9.04~~	~~-5.56~~		~~-9.36~~	~~-10.93~~	~~-7.78~~

The distribution of sightings of branded animals during the breeding season ~~from 2001 to 2011~~ indicates an average annual net movement of sea lions from the central to the eastern Gulf of Alaska, which could have depressed trend estimates in the former and increased trend estimates in the latter region (Fritz et al. 2013)~~, but~~. ~~n~~Non-pup counts in the combined eastern-central Gulf of Alaska region increased at ~~3.23~~3.67% y^{-1} (~~2.00-4.50~~2.36-5.08% y^{-1}) between 2000 and ~~2013~~2014 (Table 1). Although less is known about inter-regional movement west of Samalga Pass, including Russia, sea lion dispersal during the breeding season may have had a smaller influence on non-pup trends here than in the eastern-central Gulf of Alaska given the much larger area over which regional non-pup (and pup) trends are declining (see discussion of Russia below).

Fritz et al. (2013) estimated the magnitude of cross-boundary movement of Steller sea lions between the western and eastern stocks using transition probabilities of individually marked sea lions by sex, age, and region estimated by Jemison et al. (2013); survival rates by age, sex, and region estimated by Hastings et al. (2011) and Fritz et al. (2014); and pup production by region based on aerial surveys conducted in 2009. There was an estimated average net annual movement of only ~200 sea lions from ~~s~~Southeast Alaska (eastern stock) to the western stock during the breeding season. Given that only approximately 60% of sea lions are hauled out and available to be counted during breeding season aerial surveys (see summary of sightability by age and sex in Holmes et al. 2007), an average net movement of this magnitude represents a very small (<0.5%) percentage of the total count of sea lions in the western stock or ~~s~~Southeast Alaska~~,~~ and would have a negligible impact on non-pup trend estimates in either area. However, there were significant differences by sex and age in the cross-boundary movement, with a net increase of ~400 females in ~~s~~Southeast Alaska (eastern stock) and a net increase of ~600 males in the western stock. The pattern of movement is supported by mitochondrial DNA evidence that indicated that the newest rookeries in northern ~~s~~Southeast Alaska (eastern stock) were colonized in part by western females (Gelatt et al. 2007, O'Corry-Crowe et al. 2014).

Burkanov and Loughlin (2005) estimated that the Russian Steller sea lion population (pups and non-pups) declined from about 27,000 in the 1960s to 13,000 in the 1990s~~,~~ and increased to approximately 16,000 in 2005. Data collected through 2012 (V. Burkanov, pers. comm.) indicate~~s~~ that overall Steller sea lion abundance in Russia has continued to increase and is now similar to the 1960s (27,100 based on life table multiplier of 4.5 on the most recent total pup count). Between 1995 and 2011/2012, pup production has increased overall in Russia by 3.1% per year (V. Burkanov, pers. comm., 27 February 2013). However, just as in the U.S. portion of the stock, there are significant regional differences in population trend in Russia. Pup production in the combined Kuril Islands and the Sea of Okhotsk areas increased 59% between 1995 and 1997 (3,596 pups) and 2011 (5,729 pups), while non-pup counts increased 87% over the same time period (6,205 to 11,576). However, Steller sea lion population trends in eastern Kamchatka, the Commander Islands, and the western Bering Sea have been quite different. In eastern Kamchatka~~;~~, pup production at the single rookery (Kozlova Cape) declined 50% between the mid-1980s (~200 pups) and 2012 (101 pups), while non-pup counts were 80% lower in 2010 than in the early 1980s. On the Commander Islands, non-pup counts increased between 1930 and the late 1970s, when the rookery became re-established. Pup production on the Commander Islands increased to a maximum of 280 in 1998 and has varied between 180 and 228 since then (through 2012). Non-pup counts on the Commander Islands also reached a maximum in 1998-1999 (mean of 880), and since then have ranged between 581 and 797 (through 2010). The largest decline in Steller sea lions in Russia has been in the western Bering Sea (which has no rookeries), where non-pup counts declined 98% between 1982 and 2010. The overall increase in the abundance of Steller sea lions in Russia is due entirely to recovery and increases in abundance in the Kuril Islands and Sea of Okhotsk. Regions in Russia that are either stable or declining (eastern Kamchatka, Commander Islands, and ~~the~~ western Bering Sea) border regions in the U.~~nited~~ S.~~tates~~ where sea lion trends are similar (Aleutian Islands west of 170°W).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of maximum net productivity rate for Steller sea lions. Hence, until additional data become available, it is recommended that the theoretical maximum net productivity rate (R_{MAX}) for pinnipeds of 12% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the default value for stocks listed as "endangered" under the E~~ndangered Species~~ A~~ct~~ (Wade and Angliss 1997). Thus, for the U.S. portion of the western stock of Steller sea lions, PBR = ~~292~~297 animals (~~48,676~~49,497 × 0.06 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~New Serious Injury Guidelines~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Between ~~2008 and 2012~~2009 and 2013, ~~there were incidental~~ serious injur~~ies~~y and mortalit~~ies~~y of western Steller sea lions was observed in the following 7 fisheries of the 22 federally regulated commercial fisheries in Alaska that are monitored for incidental mortality and serious injury by fisheries observers: Bering Sea/Aleutian Islands Atka mackerel trawl, Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands Pacific cod trawl, Bering Sea/Aleutian Islands pollock trawl, Gulf of Alaska Pacific cod trawl, Gulf of Alaska Pacific cod longline, and Gulf of Alaska sablefish longline fisheries (Table 2).

Observers also monitored the Alaska State-managed Prince William Sound salmon drift gillnet fishery in 1990 and 1991, recording ~~2~~two mortalities in 1991, extrapolated to 29 (95% CI: 1-108) ~~kills~~ for the entire fishery (Wynne et al. 1992). No ~~mortalities~~mortality ~~were~~was observed during 1990 for this fishery (Wynne et al. 1991), resulting in a mean ~~kill~~annual mortality rate of 14.5 (CV = 1.0) ~~animals~~sea lions per year for 1990 and 1991. ~~In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet. In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). The Alaska Peninsula and Aleutian Islands salmon drift gillnet fishery was also monitored during 1990 (roughly 4% observer coverage) and no Steller sea lion mortalities were observed.~~ It is not known whether ~~these~~this incidental mortality ~~levels~~rate ~~are~~is representative of the current ~~incidental mortality levels~~rate in ~~these~~this fisher~~ies~~y.

~~An observer program for the Cook Inlet salmon set and drift gillnet fisheries was implemented in 1999 and 2000 in response to the concern that there may be significant numbers of marine mammal injuries and mortalities that occur incidental to these fisheries. Observer coverage in the Cook Inlet drift gillnet fishery was 1.75% and 3.73% in 1999 and 2000, respectively. The observer coverage in the Cook Inlet set gillnet fishery was 7.3% and 8.3% in 1999 and 2000, respectively (Manly 2006). There were no mortalities of Steller sea lions observed in the set or drift gillnet fisheries in either 1999 or 2000 (Manly 2006). An observer program conducted for a portion of the Kodiak drift gillnet fishery in 2002 did not observe any serious injuries or mortalities of Steller sea lions, although Steller sea lions were frequently observed in the vicinity of the gear (Manly et al. 2003).~~Combining the mortality and serious injury estimates from the Bering Sea/Aleutian Islands groundfish trawl, Gulf of Alaska groundfish trawl, and Gulf of Alaska longline fisheries ~~presented above~~ (~~17.0~~16) with the ~~mortality~~ estimate from the Prince William Sound salmon drift gillnet fishery (~~14.5~~15) results in an estimated mean annual mortality and serious injury rate in the observed fisheries of ~~31.5 (CV = 0.46)~~31 sea lions per year from this stock (Table 2).

Table 2. Summary of incidental mortality and serious injury of the Western U.S. stock of Steller sea lions ~~(western U. S. stock)~~ due to commercial fisheries ~~from 2008 through 2012~~in 2009-2013 (or the most recent data available) and calculation of the mean annual mortality and serious injury rate (Wynne et al. 1991, 1992; Breiwick 2013; NMML, unpubl. data). ~~Mean annual mortality in brackets represents a minimum estimate from stranding data. The most recent 5 years of available data, or best available information, are used in the mortality for a particular fishery.~~ N/A indicates that data are not available. ~~Details of how~~Methods for calculating percent observer coverage ~~is measured~~ are ~~included~~described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Bering Sea/Aleutian Is. Atka mackerel trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~100~~ 99% ~~100~~99% ~~100~~99% ~~100~~99% 99%	~~0~~ 0 1 0 0 0	~~0~~ 0 1~~.0~~ 0 0 0	0.2~~0~~ (CV = 0.05)
Bering Sea/Aleutian Is. flatfish trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~100~~ ~~100~~99% ~~100~~99% ~~100~~99% ~~100~~99% 99%	~~11~~ 3 4 (+1)~~*~~[a] 7 6 7	~~11.0~~ 3.0 ~~4.0~~4 (+1)~~**~~[b] 7~~.0~~ 6.0 7.0	~~6.41~~5.6 (CV = ~~0.01~~N/A)
Bering Sea/Aleutian Is. Pacific cod trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~59~~ 63% 66% 60% 68% 80%	~~0~~ 0 1 1 0 1	~~0~~ 0 1~~.0~~ 1.0 0 1.9	~~0.4~~0.8 (CV = ~~0.06~~0.33)
Bering Sea/Aleutian Is. pollock trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~85~~ 86% 86% 98% 98% 97%	~~8~~ 6 5 9 7 (+1)[c] 5	~~10.1~~ 6.2 8.2 9.3 7~~.0~~ (+1)[d] 5.1	~~8.18~~7.4 (CV = ~~0.09~~N/A)
Gulf of Alaska Pacific cod longline	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~15~~ 21% ~~28~~29% ~~30~~31% 13% 28%	~~1~~ 0 1 0 0 0	~~1.6~~ 0 1.1 0 0 0	~~0.54~~0.2 (CV = ~~0.39~~0.32)
Gulf of Alaska Pacific cod trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~15~~ 29% 31% 41% 25% 11%	~~0~~ 0 0 0 1 0	~~0~~ 0 0 0 1~~.0~~ 0	0.2 (CV = 0~~.0~~)
Gulf of Alaska sablefish longline	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~16~~ 16% 15% 14% 14% 13%	~~0~~ 0 0 0 1 0	~~0~~ 0 0 0 5.5 0	1.1 (CV = 0.91)
Prince William Sound salmon drift gillnet	1990 1991	obs data	4% 5%	0 2	0 29	~~14.5~~15 (CV = 1.0)

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
~~Prince William Sound salmon set gillnet~~	~~1990~~	~~obs data~~	~~3%~~	~~0~~	~~0~~	~~0~~
~~Alaska Peninsula/Aleutian Islands salmon drift gillnet~~	~~1990~~	~~obs data~~	~~4%~~	~~0~~	~~0~~	~~0~~
~~Cook Inlet salmon set gillnet~~	~~1999-2000~~	~~obs data~~	~~2-5%~~	~~0~~ ~~0~~	~~0, 0~~	~~0~~
~~Cook Inlet salmon drift gillnet~~	~~1999-2000~~	~~obs data~~	~~2-5%~~	~~0~~ ~~0~~	~~0, 0~~	~~0~~
~~Kodiak Island salmon set gillnet~~	~~2002~~	~~obs data~~	~~6.0%~~	~~0~~	~~0~~	~~0~~
Minimum total estimated annual mortality						~~31.5~~31 (CV = ~~0.46~~0.87)

~~*~~[a]Total mortality~~ies~~ and serious injury observed in 2010: 4 in sampled hauls + 1 in an unsampled haul~~s~~.
~~**~~[b]~~Total mortalities observed in sampled and unsampled hauls is in parentheses. In cases where~~ Since the total known mortality and serious injury (4 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (4) for the fishery in ~~a given year~~2010, the ~~sum of~~ observed mortality~~ies~~ and serious injury (~~both~~ in sampled ~~and~~+ unsampled hauls) will be used as a minimum estimate for that year.
[c]Total mortality and serious injury observed in 2012: 7 in sampled hauls + 1 in an unsampled haul.
[d]Since the total known mortality and serious injury (7 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (7) for the fishery in 2012, the observed mortality and serious injury (in sampled + unsampled hauls) will be used as a minimum estimate for that year.

Reports from the NMFS Alaska Region stranding database of Steller sea lions entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality and serious injury data (Helker et al. 2015; Table 3). During the 5-year period from ~~2008 to 2012~~2009 to 2013, there were six confirmed fishery-related Steller sea lion strandings in the range of the western stock. Five ~~sightings~~reports involved a Steller sea lion ~~that was reported to be~~ in ~~bad~~poor body condition ~~and observed~~ with a flasher lure hanging from its mouth~~;~~ and, in each case, ~~it~~the animal was believed to have ingested the hook (Table 3). ~~Another had~~The sixth animal had a string leader line hanging out of its mouth, with a hook apparently inside ~~the~~its mouth. Fishery-related strandings during ~~2008-2012~~2009-2013 resulted in an estimated average annual mortality and serious injury rate of 1.2 animals from this stock. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found or reported. Additionally, since Steller sea lions from parts of the western stock are known to travel to parts of Southeast Alaska to forage, and higher rates of entanglement of Steller sea lions have been observed in this area (e.g., see Raum-Suryan et al. 2009), estimates based solely on stranding reports in areas west of 144°W longitude may underestimate the total entanglement of western stock animals in fishery-related and other marine debris. Steller sea lions reported in the stranding database as shot are not included in this estimate, as they may ~~result from~~have been animals that were struck and lost in the Alaska Native subsistence harvest.

Table 3. Summary of ~~w~~Western U.S. Steller sea lion mortalityies and serious injuryies by year and type reported to the NMFS Alaska Regional~~al Office~~, marine mammal stranding database, and Alaska Department of Fish and Game ~~for the 2008-2012 period~~in 2009-2013 (~~Allen et al. 2014,~~ Helker et al. 2015).

Cause of ~~I~~injury	~~**2008**~~	**2009**	**2010**	**2011**	**2012**	**2013**	**Mean ~~A~~annual ~~M~~mortality**
Swallowed troll gear	~~0~~	1	0	1	3	0*	1
Ring neck entanglement (packing band)	~~5~~	1	2	0	1	0*	~~1.8~~ 0.8
Ring neck entanglement (unknown marine debris/gear)	~~1~~	0	3	1	1	0*	~~1.2~~ 1
Swallowed unknown fishing gear	~~0~~	0	1	0	0	0	0.2
Shot with arrow		0	0	0	0	1	0.2
Entangled in aquaculture facility net		0	0	0	0	1	0.2
~~Minimum total annual mortality~~							~~4.2~~

*The 2013 Alaska Department of Fish and Game entanglement and flasher injury data are not included. Thus, this number is artificially low and will be revised as data become available.

NMFS studies using satellite-tracking devices attached to Steller sea lions suggest that they rarely go beyond the U.S. Exclusive Economic Zone into international waters (Merrick and Loughlin 1997; Lander et al. 2009, 2011a, 2011b; NMML, unpubl. data).~~ Given that the high-seas gillnet fisheries have been prohibited and other net fisheries in international waters are minimal, the probability that Steller sea lions are taken incidentally in commercial fisheries in international waters is very low. NMFS concludes that the number of Steller sea lions taken incidental to commercial fisheries in international waters is insignificant.~~

The minimum average estimated mortality and serious injury rate incidental to U.S. commercial fisheries is ~~31.5~~31 Steller sea lions per year. Based on observer data (~~31.5~~31) and stranding data (1.2), the minimum average annual estimated mortality and serious injury rate incidental to commercial and recreational fisheries~~, as well as other marine debris,~~ is 32~~.7~~ Steller sea lions. Observer data on state fisheries dates as far back as 1990; however, these are the best data available to estimate takes in these fisheries. No observers have been assigned to several fisheries that are known to interact with this stock, ~~making~~thus, the estimated mortality and serious injury is likely an underestimate of the actual ~~mortality~~ level.

Alaska Native Subsistence/~~Native~~ Harvest Information

Information on the subsistence harvest of Steller sea lions comes via two sources: the Alaska Department of Fish and Game (ADF&G) and the Ecosystem Conservation Office (ECO) of the Aleut Community of St. Paul. The ADF&G conducted systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the range of the Steller sea lion in Alaska (Wolfe et al. 2005). The interviews were conducted once per year in the winter (January to March) and covered hunter activities for the previous calendar year. As of 2009, annual statewide data on community subsistence harvests are no longer being collected. Data are being collected periodically in subareas. Therefore, the most recent 5 years of data (2004-2008) will be retained and used for ~~estimating~~calculating an annual mortality and serious injury estimate for all areas except St. Paul. Data from St. Paul are still being collected and will be updated with the most recent 5-year period available. The ECO collects data on the harvest in near real-time on St. Paul Island~~,~~ and records hunter activities within 36 hours of the harvest (Zavadil 2010). Information on subsistence harvest levels is provided in Table 4; data from ECO (e.g., Zavadil 2010) are relied upon as the source of data for St. Paul Island and all other data are from the ADF&G (e.g., Wolfe et al. 2005). Data were collected on the Alaska Native harvest of Steller sea lions for ~~7~~seven communities on Kodiak Island ~~for~~in 2011; the Alaska Native Harbor Seal Commission and ADF&G estimated a total of 20 adult sea lions were harvested, with a 95% confidence range between 15 to 28 animals (Wolfe et al. 2012). This estimate does not represent a comprehensive statewide estimate; therefore, the best available statewide subsistence harvest estimates for a 5-year period are those from 2004 to 2008. No monitoring occurred on St. Paul in 2012; therefore, the most recent 5 years of data from St. Paul are from 2008-2011 and 2013.

The mean annual subsistence take from this stock for all areas except St. Paul ~~over the 5-year period from 2004 through 2008~~in 2004-2008, combined with the mean annual take ~~over the 2007-2011 period from~~for St. Paul in 2008-2011 and 2013, was 199 Steller sea lions per ~~/~~year (Table 4).

Table 4. Summary of the subsistence harvest data for the ~~w~~Western U.S. stock of Steller sea lions. As of 2009, data on community subsistence harvests are no longer being collected. Therefore, the most recent 5 years of data (2004-2008) will be retained and used for ~~estimating~~calculating an annual mortality and serious injury estimate for all areas except St. Paul. Data from St. Paul are still being collected and will be updated with the most recent 5 years of data ~~period~~ available (~~2007~~2008-2011 and 2013).

	All areas except St. Paul Island			St. Paul Island	
Year	**Number harvested**	**Number struck and lost**	**Total**	**Number harvested + struck and lost**	**Total take**
2004	136.8	49.1	185.9[~~1~~a]		
2005	153.2	27.6	180.8[~~2~~b]		
2006	114.3	33.1	147.4[~~3~~c]		
2007	165.7	45.2	210.9[~~4~~d]	~~34~~[~~6~~]	~~245~~
2008	114.7	21.6	136.3[~~5~~e]	22[~~7~~f]	158
2009	N/A	N/A	N/A	26[~~8~~g]	N/A
2010	N/A	N/A	N/A	20[~~9~~h]	N/A
2011	N/A	N/A	N/A	32[~~10~~i]	N/A
2012	N/A	N/A	N/A	N/A	N/A
2013	N/A	N/A	N/A	34[j]	N/A
Mean annual take	136.9	35.3	172.3	26.8	199

[~~1~~a]Wolfe et al. (2005); [~~2~~b]Wolfe et al. (2006); [~~3~~c]Wolfe et al. (2008); [~~4~~d]Wolfe et al. (2009a); [~~5~~e]Wolfe et al. (2009b); [~~6~~]~~Lestenkof et al. 2008,~~ [~~7~~f]Jones (2009)~~,~~; [~~8~~g]Zavidil (2010)~~,~~; [~~9~~h]Lestenkof (2011)~~,~~; [~~10~~i]Lestenkof (2012), [j]ADF&G, unpubl. data.

Other Mortality

Reports from the NMFS Alaska Region stranding database of Steller sea lions entangled in marine debris or with injuries caused by other types of human interaction are another source of mortality and serious injury data. ~~During the 5-year period from 2008 to 2012~~From 2009 to 2013, ~~15~~nine animals were observed with circumferential neck entanglements from packing bands or other unknown marine debris/gear, one animal was shot with an arrow, and one entangled in an aquaculture facility net (Table 3). The mean annual mortality and serious injury rate from these ~~other~~ sources of human interactions for ~~2008-2012~~2009-2013 is ~~3.0~~2.2 sea lions from this stock.

Mortalit~~ies~~y and serious injury may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 2008 and 2012, there was ~~a total of 0~~ no reported mortalit~~ies~~y or serious injury resulting from research on the western stock of Steller sea lions (~~T. Adams,~~ Division of Permits and~~,~~ Conservation~~, and Education Division~~, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910).

STATUS OF STOCK

The current annual level of incidental U.S. commercial fishery-related mortality and serious injury (31~~.5~~) exceeds 10% of the PBR (~~29~~30) and, therefore, cannot be considered insignificant and approaching a zero mortality and serious injury rate. Based on available data, the estimated annual level of total human-caused mortality and serious injury (31~~.5~~ ~~[~~(commercial fisheries)~~]~~ + ~~4.2~~1.2 ~~[~~(unknown fisheries~~ and marine debris~~)~~]~~ + 199 ~~[~~(Alaska Native harvest)~~]~~ + ~~3.0~~2.2 ~~[~~(entanglement in marine debris/gear and other human-interaction)~~]~~ = ~~237.7~~233) is below the PBR level (~~292~~297) for this stock. The ~~w~~Western U.S. stock of Steller sea lions is currently listed as "endangered" under the ESA, and therefore designated as "depleted" under the MMPA. As a result, the stock is classified as a strategic stock. However, the population previously declined for unknown reasons that are not explained by the level of direct human-caused mortality and serious injury.

~~Demographic criteria for down- and de-listing western Steller sea lions under the ESA are based primarily on population trend estimates rather than absolute abundance thresholds (NMFS 2008). This is due to the uncertainties related to estimating total population size based on a life table (e.g., a multiplier of total pup production) or using a proportion hauled out to estimate animals at sea during surveys. For down-listing to threatened status, the western stock in Alaska should have had a significantly positive trend in abundance for 15~~

~~years (beginning in 2000), trends in 5 of the 7 sub-regions (three each in the Aleutian Islands and Gulf of Alaska plus all of Russia) should be consistent with the overall Alaska western stock trend, and no two adjacent sub-regions should have significant negative abundance trends. Using data collected through 2012, Fritz et al. (2013) concluded that the western stock in Alaska may be on a trajectory to satisfy the first demographic criterion for down-listing if the overall counts continue to increase through 2015. The second and third demographic criteria, however, involve regional population performance, which has varied across the range. The western stock may satisfy the second criterion if counts in the eastern, central and western Gulf of Alaska, eastern Aleutian Islands, and Russia (overall) continue to increase through 2015, but satisfying the third criterion by 2015 will likely depend on an improvement in central Aleutian Island trends.~~

~~Habitat Concerns~~HABITAT CONCERNS

Many factors have been suggested as causes of the steep decline in abundance of western Steller sea lions observed in the 1980s, including competitive effects of fishing, environmental change, disease, contaminants, killer whale predation, incidental take, and illegal and legal shooting (Atkinson et al. 2008, NMFS 2008). Potential threats to Steller sea lion recovery are shown in Table 5. A number of management actions have been implemented between 1990 and 2011 to promote the recovery of the ~~w~~Western U.S. stock of Steller sea lions, including 3 nautical mile (nmi) no-entry zones around rookeries, prohibition of shooting at or near sea lions, and regulation of fisheries for sea lion prey species (e.g., walleye pollock, Pacific cod, and Atka mackerel; see reviews by Fritz et al. 1995, McBeath 2004, Atkinson et al. 2008, NMFS 2008).

Table 5. Potential threats and impacts to Steller sea lion recovery and associated references. Threats and impact to recovery as described by the Revised Steller Sea Lion Recovery Plan (NMFS 2008). Reference examples identify research related to corresponding threats and may or may not support the underlying hypotheses.

Threat	Impact on Recovery	Reference Examples
Environmental variability	Potentially high	Trites and Donnelly 2003, Fritz and Hinckley 2005~~, Trites and Donnelly 2003~~
Competition with fisheries	Potentially high	Fritz and Ferrero 1998, Hennen 2004, Fritz and Brown 2005, Dillingham et al. 2006~~, Fritz and Brown 2005, Hennen 2004, Fritz and Ferrero 1998~~
Predation by killer whales	Potentially high	Springer et al. 2003, Williams et al. 2004, DeMaster et al. 2006, Trites et al. 2007~~, Williams et al. 2004, Springer et al. 2003~~
Toxic substances	Medium	Calkins et al. 1994, Lee et al. 1996, Albers and Loughlin 2003~~, Lee et al. 1996, Calkins et al. 1994~~
Incidental take by fisheries	Low	Wynne et al. 1992, Nikulin and Burkanov 2000, Perez 2006~~, Nikulin and Burkanov 2000, Wynne et al. 1992~~
Subsistence harvest	Low	Haynes and Mishler 1991, Loughlin and York 2000, Wolfe et al. 2005~~, Loughlin and York 2000, Haynes and Mishler 1991~~
Illegal shooting	Low	Loughlin and York 2000, NMFS 2001~~, Loughlin and York 2000~~
Entanglement in marine debris	Low	Calkins 1985
Disease and parasitism	Low	Burek et al. 2005
Disturbance from vessel traffic and tourism	Low	Kucey and Trites 2006
Disturbance or mortality due to research activities	Low	Calkins and Pitcher 1982, Loughlin and York 2000, Kucey 2005, Kucey and Trites 2006, Atkinson et al. 2008,~~ Kucey and Trites 2006, Kucey 2005, Loughlin and York 2000, Calkins and Pitcher 1982,~~ Wilson et al. 2012

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NORTHERN FUR SEAL (*Callorhinus ursinus*): Eastern Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern fur seals occur from southern California north to the Bering Sea (Fig. 1) and west to the Okhotsk Sea and Honshu Island, Japan. During the summer breeding season, most of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals on rookeries in Russia, on Bogoslof Island in the southern Bering Sea, ~~and ~~on San Miguel Island off southern California (Lander and Kajimura 1982, NMFS 1993), and the Farallon Islands off central California. Non-breeding northern fur seals may occasionally haul out on land at other sites in Alaska, British Columbia, and on islets along the west coast of the United States (Fiscus 1983).

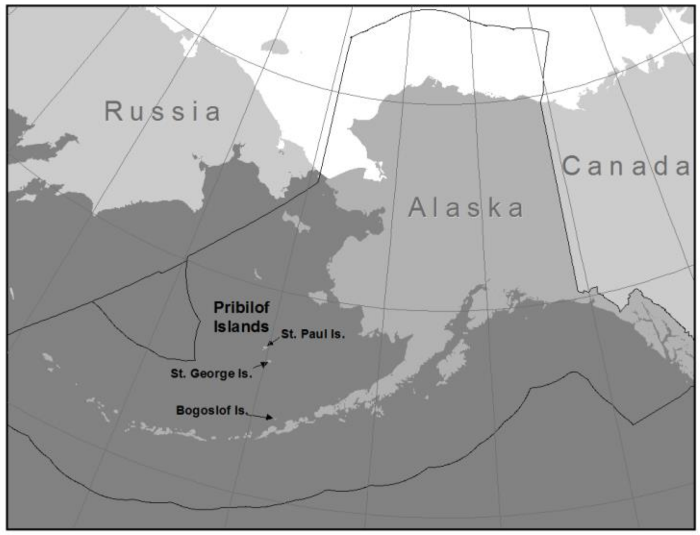

Figure 1. Approximate distribution of northern fur seals in the eastern North Pacific (dark shaded area).

During the reproductive season, adult males usually are on shore during the 4-month period from May to -August, though some may be present until November (well after giving up their territories). Adult females are ashore during a 6-month period (June-November). Following their respective times ashore, seals of both genders then move south and remain at sea until the next breeding season (Roppel 1984). Adult females and pups from the Pribilof Islands move through the Aleutian Islands into the North Pacific Ocean, often to the waters offshore of Oregon and California. Adult males generally move only as far south as the Gulf of Alaska in the eastern North Pacific (Kajimura 1984) and the Kuril Islands in the western North Pacific (Loughlin et al. 1999). In Alaska, pups are born during summer months, leave the rookeries in the fall, on average around mid-November but ranging ~~between~~from late October to early December, and generally remain at sea for 22 months before returning to their rookery of birth. There is considerable interchange of individuals between rookeries.

Two separate stocks of northern fur seals are recognized within U.S. waters based on the Dizon et al. (1992) phylogeographic approach:– 1) ~~d~~Distribution: continuous during non-breeding season and discontinuous during the breeding season, high natal site fidelity (Baker et al. 1995, DeLong 1982); 2) ~~p~~Population response: substantial differences in population dynamics between Pribilof Islands and San Miguel Island (DeLong 1982, DeLong and Antonelis 1991, NMFS 1993); 3) ~~p~~Phenotypic differentiation: unknown; and 4) ~~g~~Genotypic differentiation: little evidence of genetic differentiation among breeding islands (~~Dickerson et al. 2010, ~~Ream 2002, Dickerson et al. 2010). Thus, an Eastern Pacific stock and a ~~San Miguel Island~~California stock are recognized. The ~~San Miguel Island~~California stock is reported separately in the Stock Assessment Reports for the U.S. Pacific Region.

POPULATION SIZE

The population estimate for the Eastern Pacific stock of northern fur seals is calculated as the estimated number of pups born at rookeries in the eastern Bering Sea multiplied by a series of different expansion factors determined from a life table analysis to estimate the number of yearlings, 2-year-olds, 3-year-olds, and animals 4 or more years old (Lander 1981). The resulting population estimate is equal to the pup production estimate multiplied by 4.5. Juvenile northern fur seals are pelagic and are not included in the rookery counts. The expansion factor is based on a sex and age distribution estimated after the harvest of juvenile males was terminated. CVs are unavailable for the expansion factor. As the great majority of pups are born on St. Paul and St. George Islands, pup surveys are conducted biennially on these islands. Counts are available less frequently on Sea Lion Rock (adjacent to St. Paul Island) and Bogoslof Island (Table 1). The most recent estimate for the number of fur seals in the

Eastern Pacific stock, based on pup counts on Sea Lion Rock (2008), on St. Paul and St. George Islands (mean of 2008, 2010, and 2012), and on Bogoslof Island (2011), is 648,534 (4.47 × 145,086).

Table 1. Estimates and/or counts of northern fur seal pups born on the Pribilof Islands and Bogoslof Island. Standard errors for pup estimates at rookery locations and the CV for total pup production estimates are provided in parentheses (direct counts do not have standard errors). The " symbol indicates that no new data are available for that year and, thus, the most recent estimate/count was used in determining total annual estimates.

	Rookery location				
Year	**St. Paul**	**Sea Lion Rock**	**St. George**	**Bogoslof**	**Total**
1992*	182,437 (8,919)	10,217 (568)	25,160 (707)	898 (N/A)	218,712 (0.041)
1994	192,104 (8,180)	12,891 (989)	22,244 (410)	1,472 (N/A)	228,711 (0.036)
1996	170,125 (21,244)	"	27,385 (294)	1,272 (N/A)	211,673 (0.10)
1998	179,149 (6,193)	"	22,090 (222)	5,096 (33)	219,226 (0.029)
2000	158,736 (17,284)	"	20,176 (271)	"	196,899 (0.089)
2002	145,716 (1,629)	8,262(191)	17,593 (527)	"	176,667 (0.01)
2004	122,825 (1,290)	"	16,876 (239)	"	153,059 (0.01)
2005	"	"	"	12,631 (335)	160,594 (0.01)
2006	109, 961 (1,520)	"	17,072 (144)	"	147,900 (0.011)
2007	"	"	"	17,574 (843)	152,867 (0.011)
2008	102,674 (1,084)	6,741 (80)	18,160 (288)	"	145,149 (0.009)
2010	94,502 (1,259)	"	17,973 (323)	"	136,790 (0.011)
2011	"	"	"	22,905 (921.5)	142,121 (0.011)
2012	96,828 (1,260)	"	16,184 (155)	"	142,658 (0.011)

* Incorporates the 1990 estimate for Sea Lion Rock and the 1993 count for Bogoslof Island.

Minimum Population Estimate

A CV(N) that incorporates the variance of the correction factor is not available. Consistent with a recommendation of the Alaska Scientific Review Group (SRG) in October 1997 (DeMaster 1998) and recommendations contained in Wade and Angliss (1997), a default CV(N) of 0.2 was used in the calculation of the minimum population estimate (N_{MIN}) for this stock. N_{MIN} is calculated using Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the 3-year mean population estimate (N) of 648,534 and the default CV (0.2), N_{MIN} for the Eastern Pacific stock of northern fur seals is 548,919.

Current Population Trend

Estimates of the size of the Alaska population of northern fur seals increased to approximately 1.25 million in 1974 after the termination of commercial sealing on St. George in 1972 and pelagic sealing for science in 1974; commercial sealing on St. Paul continued until 1984. The population then began to decrease with pup production declining at a rate of 6.5-7.8% per year into the 1980s (York 1987). By 1983, the total stock estimate was 877,000 (Briggs and Fowler 1984). Annual pup production on St. Paul Island remained stable between 1981 and 1996 (Fig. 2; York and Fowler 1992). There has been a decline in pup production on St. Paul Island since the mid-1990s. Pup production at St. George Island had a less pronounced period of stabilization that was similarly followed by decline. However, pup production appeared to stabilize again on St. George Island beginning around 2002 (Fig. 3). During 1998-2012, pup production declined 4.84% per year (SE = 0.49%; P < 0.01) on St. Paul Island and 1.95% per year (SE = 0.50%; P < 0.01) on St. George Island. The estimated pup production in 2012 was below the 1916 level on both St. Paul and St. George Islands (NMFS, unpubl. data). Northern fur seal pup production at Bogoslof Island has grown at an exponential rate since the 1990s (R. Ream, ~~pers. comm.,~~ NMFS, AFSC, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115, pers. comm., 5 February 2009). Despite continued growth at Bogoslof Island, recent estimates of pup production indicate that the rate of increase may be slowing. Between 2005 and 2011, pup production at Bogoslof Island increased 9.9% per year. Incorporation of the 2012 estimates from the Pribilofs shows an insignificant change in pup production on the Pribilof Islands since 2010. Temporary increases in the overall stock size are observed when opportunistic estimates are conducted at Bogoslof, but declines at the larger Pribilof colony (specifically St. Paul) continue to drive the overall stock estimate down over time.

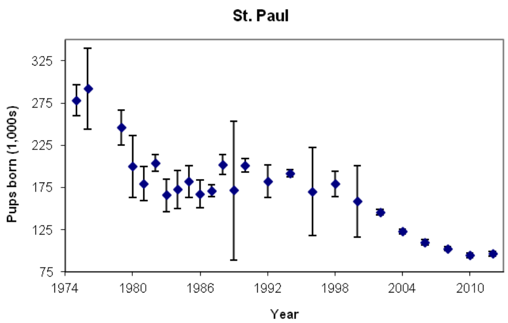

Figure 2. Estimated number of northern fur seal pups born on St. Paul Island, 1970-2012.

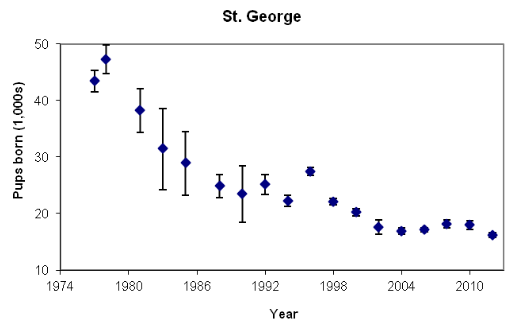

Figure 3. Estimated number of northern fur seal pups born on St. George Island, 1970-2012.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Pelagic sealing led to a decrease in the fur seal population; however, a moratorium on fur seal harvesting and termination of pelagic sealing resulted in a steady increase in the northern fur seal population during 1912-1924. During this period, the rate of population growth was approximately 8.6% (SE = 1.47) per year (A. York, ~~unpubl. data,~~ NMFS, AFSC, National Marine Mammal Laboratory (retired), 7600 Sand Point Way NE, Seattle, WA 98115, unpubl. data), the maximum recorded for this species. This growth rate is similar and slightly higher than the 8.1% rate of increase (approximate SE = 1.29) estimated by Gerrodette et al. (1985). Though not as high as growth rates estimated for other fur seal species, the 8.6% rate of increase is considered a reliable estimate of R_{MAX} given the extremely low density of the population in the early 1900s.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the ~~potential biological removal (~~PBR~~)~~ is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for depleted stocks under the MMPA (Wade and Angliss 1997). Thus, for the Eastern Pacific stock of northern fur seals, PBR = 11,802 animals (548,919 × 0.043 × 0.5).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~New Serious Injury Guidelines~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations~~

~~for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Historically, northern fur seals were known to be killed incidentally by both the foreign and the joint U.S.-foreign commercial groundfish trawl fisheries (total estimate of 246 northern fur seals killed between 1978 and 1988), as well as the foreign high-seas driftnet fisheries (total take estimate in 1991 was 5,200; 95% CI: 4,500-6,000) (Perez and Loughlin 1991, Larntz and Garrott 1993). These estimates are not included in the mortality and serious injury rate calculation in this Stock Assessment Report because the fisheries are no longer operative, although some low level of illegal fishing may still be occurring. Commercial net fisheries in international waters of the North Pacific Ocean have decreased significantly in recent years. The assumed level of incidental catch of northern fur seals in those fisheries, though unknown, is thought to be minimal (T. Loughlin, ~~pers. comm.,~~ NMFS, AFSC, National Marine Mammal Laboratory (retired), 7600 Sand Point Way NE, Seattle, WA 98115, pers. comm.).

Between ~~2008 and 2012~~2009 and 2013, ~~there were~~ incidental mortality and serious injury~~ies and mortalities~~ of northern fur seals was observed in the following 3 fisheries of the 22 federally-regulated commercial fisheries in Alaska monitored for incidental mortality by fisheries observers: Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands pollock trawl, and Bering Sea/Aleutian Islands Pacific cod longline fisheries. The total estimated mean annual fishery-related incidental mortality and serious injury rate in these fisheries from ~~2008 to 2012~~2009 to 2013 is ~~1.7~~1.1 (CV = ~~0.58~~0.23) (Table 2).

Observer programs for ~~five~~ Alaska ~~s~~State-managed commercial fisheries have not documented any ~~takes~~mortality or serious injury of northern fur seals (Wynne et al. 1991, 1992; Manly 2006, 2007). ~~In 1990 and 1991, observers monitored the Prince William Sound salmon drift gillnet fishery and recorded no mortalities of northern fur seals. In 1990, observers were on board 300 of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers were on board 531 of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). During 1990, observers also were on board 59 of the 154 vessels participating in the Alaska Peninsula/Aleutian Islands salmon drift gillnet fishery, monitoring a total of 373 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). More recently, observer programs have been conducted in the Cook Inlet salmon set and drift gillnet fisheries (Manly 2006) and in a portion of the Kodiak set gillnet fishery (Manly 2007). Observer coverage in the Cook Inlet drift gillnet fishery was 1.8% and 3.7% in 1999 and 2000, respectively. The observer coverage in the Cook Inlet set gillnet fishery was 7.3% and 8.3% in 1999 and 2000, respectively (Manly 2006). Observer coverage in the Kodiak set gillnet fishery was 6.0% (2002) and 4.9% (2005) of the fishing permit days. No serious injuries or mortalities of northern fur seals were observed during the course of any observer program.~~

Table 2. Summary of incidental mortality and serious injury of the Eastern Pacific stock of northern fur seals ~~from the eastern Pacific stock~~ due to commercial fisheries ~~from 2008 through 2012~~in 2009-2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). ~~Details of how~~Methods for calculating percent observer coverage ~~is measured~~ are ~~included~~described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Bering Sea/Aleutian Is.~~lands~~ flatfish trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~100~~ ~~100~~99% ~~100~~99% ~~100~~99% ~~100~~99% 99%	~~2~~ 1 0 (+1)~~*~~[a] 0 0 0	~~2.1~~ 1.0 0 (+1)~~**~~[b] 0 0 0	~~0.82~~0.4 (CV = ~~0.11~~N/A)

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Bering Sea/Aleutian Is.~~lands~~ pollock trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~85~~ 86% 86% 98% 98% 97%	~~1~~ 0 2 0 0 0	~~1.0~~ 0 2.0 0 0 0	~~0.61~~0.4 (CV = ~~0.06~~0.07)
Bering Sea/Aleutian Is.~~lands~~ Pacific cod longline	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~63~~ ~~61~~60% 64% 57% 51% 67%	~~0~~ 0 1 0 0 0	~~0~~ 0 1.4 0 0 0	~~0.28~~0.3 (CV = 0.52)
Minimum total estimated annual mortality						~~1.71~~1.1 (CV = ~~0.11~~0.23)

~~*~~[a]Total mortalit~~ies~~y and serious injury observed in 2010: 0 in sampled hauls + 1 in an unsampled haul~~s~~.
~~**~~[b]~~Total mortalities observed in sampled and unsampled hauls.~~ Since the total known mortality and serious injury (0 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (0) for 2010, the ~~sum of actual~~ observed mortality~~ies observed~~ and serious injury (~~1~~in sampled + unsampled hauls) will be used as a minimum estimate for that year.

~~The estimated minimum annual mortality rate incidental to commercial fisheries is 1.7 fur seals per year based on observer data. There are several fisheries that are known to interact with northern fur seals and have not been observed (Appendices 4 and 5). Thus, the estimated mortality rate is likely an underestimate of the actual mortality level. However, the large stock size makes it unlikely that unreported mortalities from those fisheries would be a significant source of mortality for the stock.~~

Entanglement studies on the Pribilof Islands are another source of information on fishery-specific interactions with fur seals. Based on entanglement rates and sample sizes presented in Zavadil et al. (2003), an average of 1.1 fur seals/year on the rookeries were entangled in pieces of trawl netting and an average of 0.1 fur seal/year was entangled in monofilament net. Zavadil et al. (2007) determined the juvenile male entanglement rate for 2005-2006 to be between 0.15 and 0.35%. The mean entanglement rate in this 2-year period for pups on St. George Island was 0.06-0.08%, with a potential maximum rate of up to 0.11% in October prior to weaning. Female entanglement rate on St. George Island increased during the course of the 2005-2006 breeding seasons, reaching a rate of 0.13% in October; this rate increase coincided with the arrival of progressively younger females on the rookery throughout the season (Zavadil et al. 2007).

Entanglements of northern fur seals have been observed on St. Paul, St. George, and Bogoslof Islands. In 2011, there was an increased effort to include entanglement reports in the NMFS Alaska Region~~al Office~~ stranding database. A summary of ~~circumferential neck~~ entanglements ~~of marine debris and~~in fishing gear between ~~2008 and 2012~~2009 and 2013 is provided in Table 3. ~~Twenty northern fur seals with circumferential neck entanglements were reported to the stranding network between 2008 and 2012.~~ The mean annual mortality and serious injury rate due to ~~circumferential neck~~ entanglement ~~from~~in trawl gear (0.4), fishing line (0.2), pot gear (0.2), and ~~unknown fishing gear (0.8)~~fishing net (0.6) in Alaska waters in 2009-2013 is ~~1.6~~1.4 ~~for the 2008-2012 period~~. These entanglements cannot be assigned to a specific fishery, and it is unknown whether commercial, recreational, or ~~Alaska Native~~ subsistence fisheries are the source of the fishing debris. There is significantly higher observation effort on the rookeries during the years of pup production (even years) than during odd numbered years, so this difference in the level of effort should be taken into consideration with estimates of entanglement based on opportunistic reports.

The Eastern Pacific stock can occur off the west coast of the continental U.S. in winter/spring; therefore, any mortality or serious injury of northern fur seals reported off the coasts of Washington, Oregon, or California during December through May will be assigned to both the Eastern Pacific and California stocks of northern fur seals. Between 2009 and 2013, two northern fur seal entanglements occurred off the Oregon coast during this time period: one in an unknown fishing net in February 2009 and one in trawl gear in April 2011 (Carretta et al. 2014; NMFS, unpubl. data), resulting in an average annual mortality and serious injury rate of 0.4 Eastern Pacific northern fur seals in these waters (Table 3). An additional northern fur seal that stranded with a serious injury, due to an unidentified fishery interaction, in May 2012 in California was treated and released with a non-serious injury (Carretta et al. 2014).

Table 3. Summary of mortality and serious injury of the Eastern Pacific stock of northern fur seals, ~~eastern Pacific stock, neck entanglements in marine debris~~ by year and type, reported to the NMFS Alaska Regiona~~l Office, marine mammal stranding database, for the 2008-2012 period~~ (~~Allen et al. 2014,~~ Helker et al. 2015) and NMFS U.S. West Coast Region (Carretta et al. 2014; NMFS, unpubl. data), marine mammal stranding databases, in 2009-2013. Only cases of serious injuries are reported in this table; animals that were disentangled and released with non-serious injuries have been excluded.

Cause of ~~I~~injury	~~2008~~	2009	2010	2011~~*~~	2012~~*~~	2013	Mean ~~A~~annual ~~M~~mortality
Entanglement (unknown fishing net)	~~0~~	~~0~~1[a]	0	0	1	0	~~0.2~~0.4
Entanglement (unknown marine debris/gear)	~~0~~	~~0~~3[a]	0	0	1	0	~~0.2~~0.8
Entanglement (trawl gear)	~~0~~	0	0	1[a]	0	0	0.2
Neck entanglement (fishing line)	~~0~~	0	0	1	0	0	0.2
Neck entanglement (fishing net)	~~0~~	0	0	0	2	0	0.4
Neck ~~E~~entanglement (packing band)	~~0~~	0	0	2	0	0	0.4
Neck entanglement (pot gear)	~~0~~	0	0	1	0	0	0.2
Neck entanglement (trawl gear)	~~0~~	0	0	2	0	0	0.4
~~Neck entanglement (unknown fishing gear)~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0.2~~ ~~0~~
Neck entanglement (unknown marine debris/gear)	~~0~~	0	0	8	3	1	~~2.2~~ 2.4
Power plant entrainment	~~0~~	0	0	0	1[a]	0	0.2
Sum of 2011, 2012 M/SI events[b]				~~14~~15	~~7~~8		~~10.5~~12
~~Minimum total annual mortality~~							~~4.4~~

[a]Mortality or serious injury that occurred off the coasts of Washington, Oregon, or California in December through May was assigned to both the Eastern Pacific and California stocks of northern fur seals.

~~*~~[b]An increase in the number of reports is not necessarily an indication of an increase in occurrence of entanglements~~,~~ but rather is a reflection of more thorough reporting of these events in the NMFS Alaska Regiona~~l Office~~ stranding database as of 2011. The average of the sum of mortality/serious injury (M/SI) events reported in 2011 and 2012 may be a more accurate number of annual M/SI for management purposes due to more thorough reporting for those years.

Alaska Native Subsistence/~~Native~~ Harvest Information

Alaska Natives residing on the Pribilof Islands are allowed an annual subsistence harvest of northern fur seals, with a 3-year take range based on historic local needs. Typically, only juvenile males are taken in the subsistence harvest, which results in a much smaller impact on population growth than a harvest that includes females. However, accidental harvesting of females and adult males does occur. ~~Of the 331 fur seals taken for subsistence on St. Paul in 2008, 328 were sub-adult males and 3 were females (Zavadil 2008).~~ A total of 113 sub-adult males and one female were harvested on St. George in 2009 (Lekanof 2009). Only juvenile males were harvested in 2010; no females were reported as accidentally killed. A single female was killed during the harvest on St. Paul in 2011 (Lestenkof et al. 2011). One female was killed on St. George Island in 2012 (Lekanof 2013) and three females were killed on St. Paul Island in 2013 (Lestenkof et al. 2014). Between ~~2008 and 2012~~2009 and 2013, there was an annual average of ~~461~~432 seals harvested ~~per year~~ in the subsistence harvest (Table 4).

Table 4. Summary of the Alaska Native subsistence harvest of northern fur seals on St. Paul and St. George Islands ~~for 2008-2012~~in 2009-2013.

Year	St. Paul	St. George	Total harvested
~~2008~~	~~331[1]~~	~~170[2]~~	~~501~~
2009	341~~[3]~~[a]	114~~[4]~~[b]	455
2010	357~~[5]~~[c]	78~~[6]~~[d]	435
2011	323~~[7]~~[e]	120~~[8]~~[f]	443
2012	383~~[9]~~[g]	64~~[10]~~[h]	447
2013	301[i]	80[j]	381
Mean annual take (~~2008-2012~~2009-2013)			~~461~~432

~~[1]Zavadil 2008, [2]Lekanof 2008,~~ ~~[3]~~[a]Zavadil (2009), ~~[4]~~[b]Lekanof (2009), ~~[5]~~[c]Zavadil et al. (2011), ~~[6]~~[d]Merculief (2010), ~~[7]~~[e]Lestenkof et al. (2011), ~~[8]~~[f]Merculief (2011), ~~[9]~~[g]Lestenkof et al. (2012), ~~[10]~~[h]Lekanof (2013), [i]Lestenkof et al. (2014), [j]Kashevarof (2014).

Other Mortality

Intentional killing of northern fur seals by commercial fishers, sport fishers, and others may occur, but the magnitude of that mortality is unknown. Such shooting has been illegal since the species was designated as "depleted" in 1988.

Since the Eastern Pacific and California stocks of northern fur seals overlap off the west coast of the continental U.S. during December through May, non-fishery mortality and serious injury reported off the coasts of Washington, Oregon, or California during that time will be assigned to both stocks. The mean annual mortality and serious injury rate due to ~~circumferential neck~~ entanglement ~~from~~in packing bands (0.4 in Alaska waters) and unknown marine debris or gear (~~2.4~~3.2: 2.6 in Alaska waters + 0.6 in Oregon waters) is ~~2.8~~3.6 Eastern Pacific northern fur seals ~~for the 2008-2012 period~~in 2009-2013 (Table 3). An additional mean annual mortality and serious injury rate of 0.2 Eastern Pacific northern fur seals occurred in 2009-2013 due to entrainment in the cooling water system of a California power plant in 2012 (Carretta et al. 2014).

Mortality~~ies~~ and serious injury may occasionally occur incidental to marine mammal research activities authorized under Marine Mammal Protection Act (MMPA) permits issued to a variety of government, academic, and other research organizations. Between 2008 and 2012, there was a single mortality resulting from research on ~~this~~the Eastern Pacific stock of northern fur seals in 2009, for an average annual mortality and serious injury rate of 0.2 northern fur seals~~mortalities per year~~ (~~T. Adams,~~ Division of Permits~~,~~ and Conservation~~, and Education Division~~, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910). ~~The only fisheries research m~~Mortality and serious injury of ~~a~~ northern fur seals ~~for the 2008-2012 period~~ also occurred ~~in 2009~~ during a research groundfish bottom trawl ~~research~~ survey in Alaska waters in 2009 (Helker et al. 2015) and a research trawl survey in California waters in 2009 (Carretta et al. 2014), resulting in an average annual mortality and serious injury rate of ~~0.2~~0.4 northern fur seals ~~mortalities per year~~in 2008-2012. The total combined mortality~~ies~~ and serious injury of northern fur seals from marine mammal (0.2) and fisheries (~~0.2~~0.4) research activities is ~~0.4~~0.6 per year in~~for the~~ 2008-2012~~ period~~.

STATUS OF STOCK

Based on currently available data, the minimum estimated U.S. commercial fishery-related mortality and serious injury for this stock (~~1.7~~1.1) is less than 10% of the calculated PBR (1,180) and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. The estimated annual level of total human-caused mortality and serious injury (~~1.7~~1.1 ~~[~~(commercial fisheries)~~]~~ + ~~1.6~~1.8 ~~[~~(unknown fisheries)~~]~~ + ~~461~~432 ~~[~~(Alaska Native harvest)~~]~~ + ~~0.4~~0.6 ~~[~~(research activities)~~]~~ + ~~2.8~~3.6 ~~[~~(marine debris/gear)~~]~~ + 0.2 (power plant entrainment) = ~~468~~439) does not exceed the PBR (11,802) for this stock. However, given that the population is declining for unknown reasons, and this decline is not explained by the relatively low level of known direct human-caused mortality and serious injury, there is no reason to believe that limiting mortality~~ies~~ and serious injury to the level of the PBR will reverse the decline. The northern fur seal was designated as depleted under the MMPA in 1988 because population levels had declined to less than 50% of levels observed in the late 1950s (1.8 million animals; 53 FR 17888, 18 May 1988) and there was no compelling evidence that carrying capacity (K) had changed substantially since the late 1950s. The Eastern Pacific stock of northern fur seals is classified as a strategic stock because it is designated as depleted under the MMPA. This stock will remain designated as depleted until population levels reach at least the lower limit of its ~~o~~Optimum ~~s~~Sustainable ~~p~~Population (estimated at 60% of K; 1,080,000).

~~Habitat Concerns~~HABITAT CONCERNS

Northern fur seals forage on a variety of fish species, including pollock. Some historically relevant prey items, such as capelin, have disappeared entirely from fur seal diet and pollock consumption has increased (Sinclair et al. 1994, ~~Sinclair et al.~~ 1996~~,~~; Antonelis et al. 1997). Analyses of scats collected from Pribilof Island rookeries during 1987-2000 found that pollock (46-75% by frequency of occurrence, FO) and gonatid squids dominated in the diet and that other primary prey (FO>5%) included Pacific sand lance, Pacific herring, northern smoothtongue, Atka mackerel, and Pacific salmon (Zeppelin and Ream 2006). These analyses also found that diets associated with rookery complexes reflected patterns associated with foraging in the specific hydrographic domains identified by Robson et al. (2004). Comparison of ingested prey sizes based on scat and spew analysis indicate a much larger overlap between sizes of pollock consumed by fur seals and those caught by the commercial trawl fishery than was previously known (Gudmundson et al. 2006). Call et al. (2008) found northern fur seals had three types of individual foraging route tactics at the rookery, which is important to consider in the context of adaptation to changes in environmental conditions and prey distributions.

Fishing effort displaced by Steller sea lion protection measures may have moved to areas important to fur seals; recent tagging studies have shown that lactating female fur seals and juvenile males from St. Paul and St. George Islands forage in specific and very different areas (Robson et al. 2004, Sterling and Ream 2004). From 1982 to 2002, pup production declined on St. Paul and St. George Islands (Figs. 2 and 3). However, it remains unclear whether the pattern of declines in fur seal pup production on the two Pribilof Islands is related to the relative distribution of pollock fishery effort in summer on the eastern Bering Sea shelf. Adult female fur seals spend approximately eight months in varied regions of the North Pacific Ocean during winter, and forage in areas associated with eddies and the subarctic-subtropical transition region (Ream et al. 2005). Thus, environmental changes in the North Pacific Ocean could potentially have an effect on abundance and productivity of fur seals breeding in Alaska.

There is concern that a variety of human activities other than commercial fishing, such as an increase in vessel traffic in Alaska waters and an increased potential for oil spills, may impact northern fur seals. A Conservation Plan for the ~~e~~Eastern Pacific stock was released in December of 2007 (NMFS 2007). This ~~P~~plan reviews known and potential threats to the recovery of fur seals in Alaska.

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HARBOR SEAL (*Phoca vitulina richardii*)

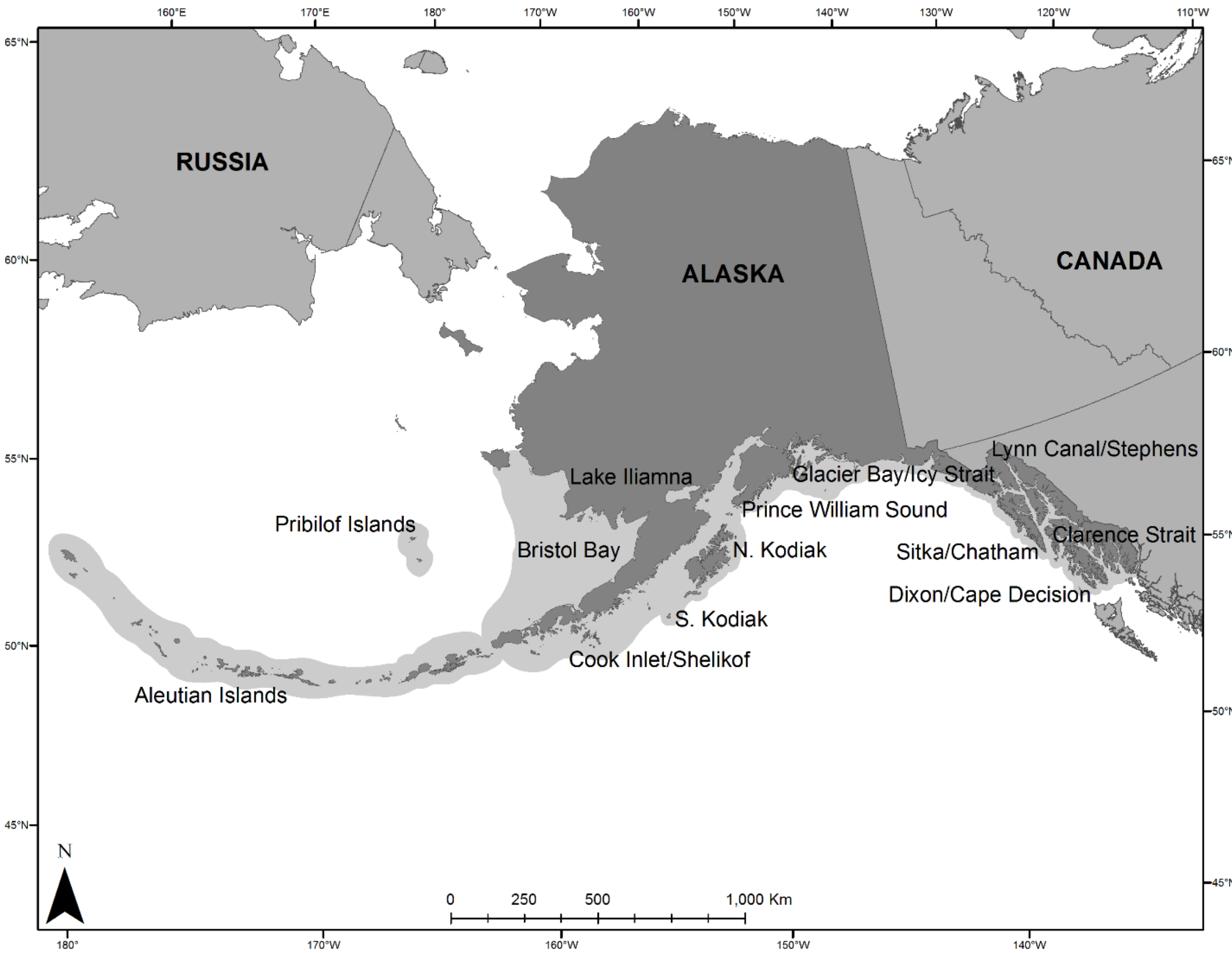


Figure 1. Approximate distribution of harbor seals in Alaska waters (shaded coastline area).

STOCK DEFINITION AND GEOGRAPHIC RANGE

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the United States, British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. They haul out on rocks, reefs, beaches, and drifting glacial ice, and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944;~~,~~ Fisher 1952;~~,~~ Bigg 1969, 1981;~~,~~ Hastings et al. 2004). The results of past and recent satellite~~–~~tagging studies in Southeast Alaska, Prince William Sound, ~~and~~ Kodiak Island, and Cook Inlet are also consistent with the conclusion that harbor seals are non-migratory (Swain et al. 1996, Lowry et al. 2001, Small et al. 2003, Boveng et al. 2012). However, some long-distance movements of tagged animals in Alaska have been recorded (Pitcher and McAllister 1981, Lowry et al. 2001, Small et al. 2003, Womble 2012, Womble and Gende 2013). Strong fidelity of individuals for haul-out sites during the breeding season has been documented in several populations (Härkönen and Harding 2001), including some harbor seal stocks in Alaska such as South Kodiak Island, Prince William Sound, Glacier Bay/Icy Strait, and Cook Inlet (Pitcher and McAllister 1981, Small et al. 2005, Boveng et al. 2012, Womble 2012, Womble and Gende 2013).

Local or regional trends in harbor seal numbers have been monitored at various time intervals since the 1970s, revealing diverse spatial patterns in apparent population trends. Where declines have been observed, they seem generally to have been strongest in the late 1970s or early 1980s to the 1990s. For example, counts of harbor seals declined by about 80% at Tugidak Island in the 1970s and 1980s (Pitcher 1990), and numbers at Nanvak Bay in northern Bristol Bay also declined at about the same time (Jemison et al. 2006). In Prince William Sound, harbor seal numbers declined by about 63% overall between 1984 and 1997, including a 40% decline prior to the *Exxon Valdez* oil spill that occurred in 1989 (Frost et al. 1999, Ver Hoef and Frost 2003). Harbor seal counts in Glacier Bay National Park, where the majority of seals haul out on floating ice calved from glaciers, declined by roughly 60% between 1992 and 2001 and continued to decline through 2008 (Mathews and Pendleton 2006, Womble et al. 2010). At Aialik Bay, a site in Kenai Fjords National Park where harbor seals also haul out on ice calved from a glacier, harbor seal numbers declined by 93% from 1979 to 2009 (Hoover-Miller et al. 2011). In the Aleutian Islands, counts declined by 67% between the early 1980s and 1999, with declines of about 86% in the western Aleutians (Small et al. 2008). Although there is evidence for recent stabilization or even partial recovery of harbor seal numbers in some areas of long-term harbor seal decline, such as Tugidak Island and Nanvak Bay (Jemison et al. 2006), most have not made substantial recoveries toward historic abundances. But these areas of declines in harbor seals contrast strongly with other large regions of Alaska where harbor seal numbers have remained stable or increased over the same period: trend monitoring regions around Ketchikan and the Kodiak area increased significantly in the 1980s and 1990s and were stable in around Sitka and Bristol Bay (Small et al. 2003). Differences in trend across the various regions of Alaska ~~Harbor seals have declined dramatically in some parts of their Alaska range over the past few decades while in other parts their numbers have increased or remained stable over similar time periods,~~ suggest~~ing areas with~~ some level of independent population dynamics (O'Corry-Crowe et al. 2003, O'Corry-Crowe 2012).

Westlake and O'Corry-Crowe's (2002) analysis of genetic information from 881 samples across 181 sites revealed population subdivisions on a scale of 600-820 km. These results suggest that genetic differences within Alaska, and most likely over their entire North Pacific range, increase with increasing geographic distance. New information revealed substantial genetic differences indicating that female dispersal occurs at region specific spatial scales of 150-540 km. This research identified 12 demographically independent clusters within the range of Alaskan harbor seals; however, significant geographic areas within the Alaskan harbor seal range remain unsampled (O'Corry-Crowe et al. 2003).

In 2010, the National Marine Fisheries Service (NMFS) and their co-management partners, the Alaska Native Harbor Seal Commission, ~~decided on~~identified 12 separate stocks of harbor seals based largely on the genetic structure; this represents a significant increase in the number of harbor seal stocks from the three stocks (Bering Sea, Gulf of Alaska, Southeast Alaska) previously recognized. Given the genetic samples were not obtained continuously throughout the range, a total evidence approach was used to consider additional factors such as population trends, observed harbor seal movements, and traditional Alaska Native use areas in the final designation of stock boundaries. ~~This represents a significant increase in the number of harbor seal stocks from the three stocks (Bering Sea, Gulf of Alaska, Southeast Alaska) previously recognized.~~ The 12 stocks of harbor seals currently identified in Alaska are 1) the Aleutian Islands stock – occurring along the entire Aleutian chain from Attu Island to Ugamak Island;~~,~~ 2) the Pribilof Islands stock – occurring on Saint Paul and Saint George Islands, as well as on Otter and Walrus Islands;~~,~~ 3) the Bristol Bay stock – ranging from Nunivak Island south to the west coast of Unimak Island and extending inland to Kvichak Bay and Lake Iliamna;~~,~~ 4) the North Kodiak stock – ranging from approximately Middle Cape on the west coast of Kodiak Island northeast to West Amatuli Island and south to Marmot and Spruce Islands;~~,~~ 5) the South Kodiak stock – ranging from Middle Cape on the west coast of Kodiak Island southwest to Chirikof Island and east along the south coast of Kodiak Island to Spruce Island, including the Trinity Islands, Tugidak Island, Sitkinak Island, Sundstrom Island, Aiaktalik Island, Geese Islands, Two Headed Island, Sitkalidak Island, Ugak Island, and Long Island;~~,~~ 6) the Prince William Sound stock – ranging from Elizabeth Island off the southwest tip of the Kenai Peninsula to Cape Fairweather, including Prince William Sound, the Copper River Delta, Icy Bay, and Yakutat Bay;~~,~~ 7) the Cook Inlet/Shelikof Strait stock – ranging from the southwest tip of Unimak Island east along the southern coast of the Alaska Peninsula to Elizabeth Island off the southwest tip of the Kenai Peninsula, including Cook Inlet, Knik Arm, and Turnagain Arm;~~,~~ 8) the Glacier Bay/Icy Strait stock – ranging from Cape Fairweather southeast to Column Point, extending inland to Glacier Bay, Icy Strait, and from Hanus Reef south to Tenakee Inlet;~~,~~ 9) the Lynn Canal/Stephens Passage stock – ranging north along the east and north coast of Admiralty Island from the north end of Kupreanof Island through Lynn Canal, including Taku Inlet, Tracy Arm, and Endicott Arm;~~,~~ 10) the Sitka/Chatham Strait stock – ranging from Cape Bingham south to Cape Ommaney, extending inland to Table Bay on the west side of Kuiu Island and north through Chatham Strait to Cube Point off the west coast of Admiralty Island, and as far east as Cape Bendel on the northeast tip of Kupreanof Island;~~,~~ 11) the Dixon/Cape Decision stock – ranging from Cape Decision on the southeast side of Kuiu Island north to Point Barrie on Kupreanof Island and extending south from Port Protection to Cape Chacon along the west coast of Prince of Wales Island and west to Cape Muzon on Dall Island, including Coronation Island, Forrester Island, and all the islands off the west coast of Prince of Wales Island;~~,~~ and 12) the

Clarence Strait stock – ranging along the east coast of Prince of Wales Island from Cape Chacon north through Clarence Strait to Point Baker and along the east coast of Mitkof and Kupreanof Islands north to Bay Point, including Ernest Sound, Behm Canal, and Pearse Canal (Fig. 1). Individual stock distributions can be seen in Figures 2a-l.

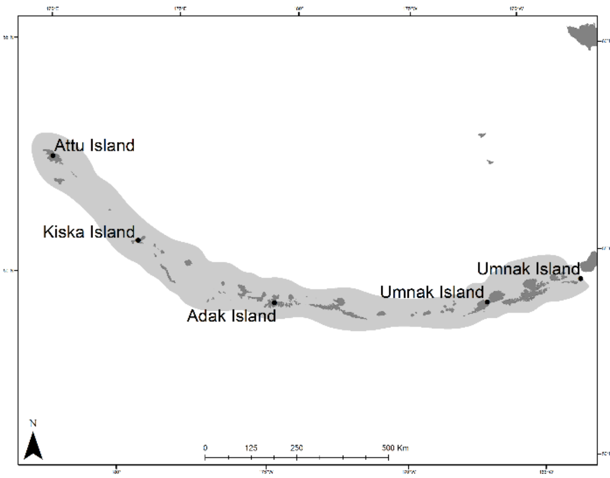


Figure 2a. Approximate distribution of Aleutian Islands harbor seal stock (shaded area).

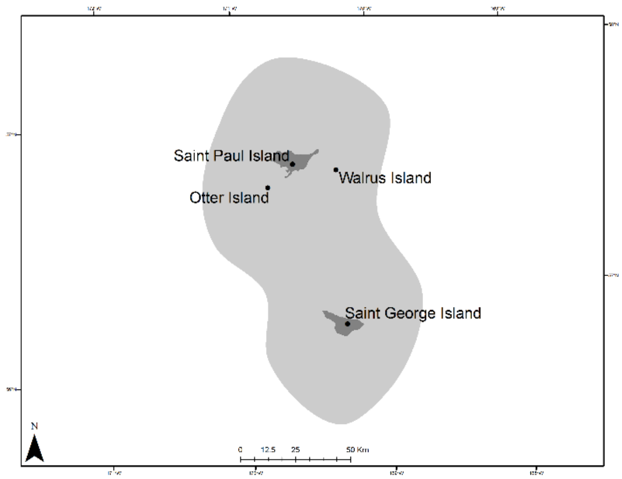


Figure 2b. Approximate distribution of Pribilof Islands harbor seal stock (shaded area).

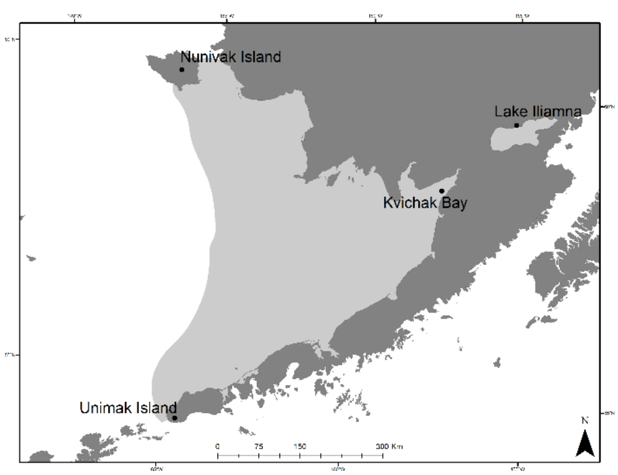


Figure 2c. Approximate distribution of Bristol Bay harbor seal stock (shaded area).

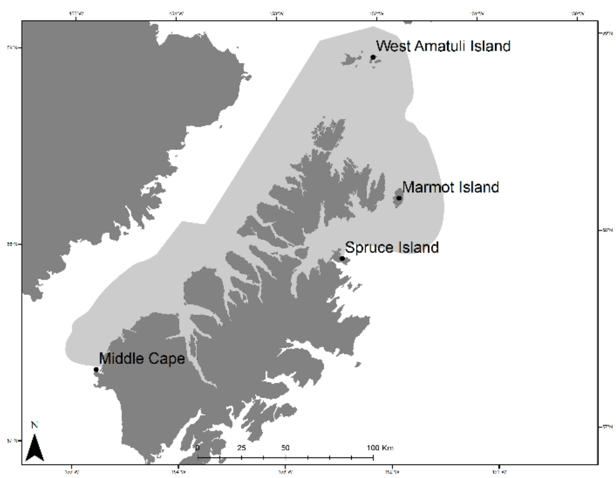


Figure 2d. Approximate distribution of North Kodiak harbor seal stock (shaded area).

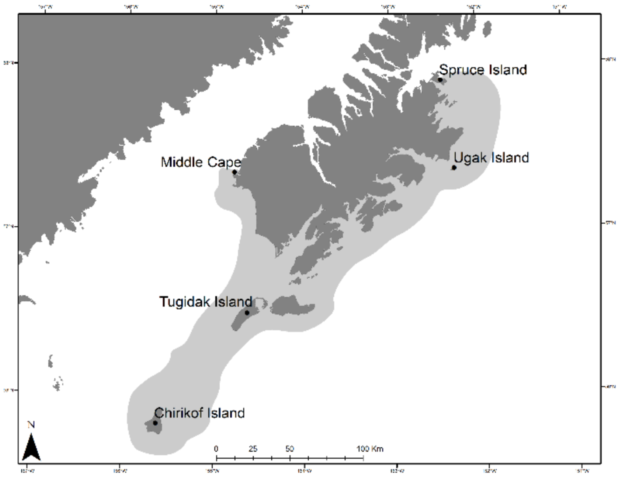


Figure 2e. Approximate distribution of South Kodiak harbor seal stock (shaded area).

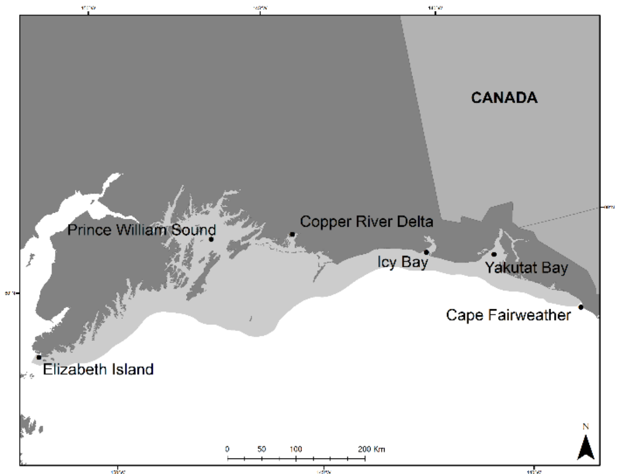


Figure 2f. Approximate distribution of Prince William Sound harbor seal stock (shaded area).

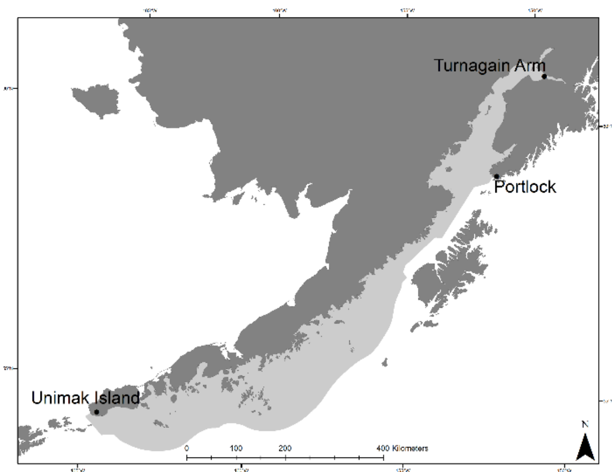


Figure 2g. Approximate distribution of Cook Inlet/Shelikof Strait harbor seal stock (shaded area).

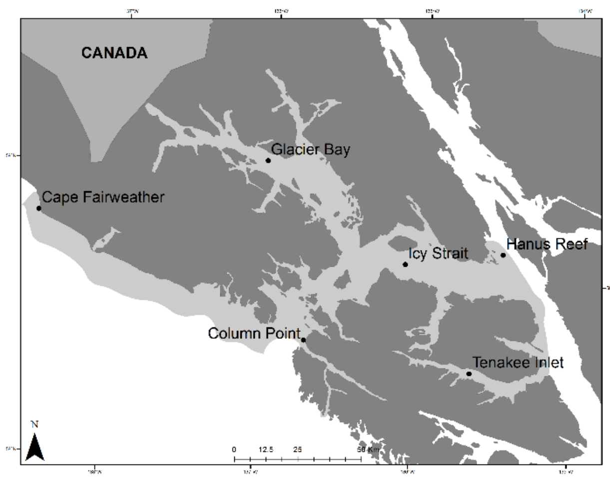


Figure 2h. Approximate distribution of Glacier Bay/Icy Strait harbor seal stock (shaded area).

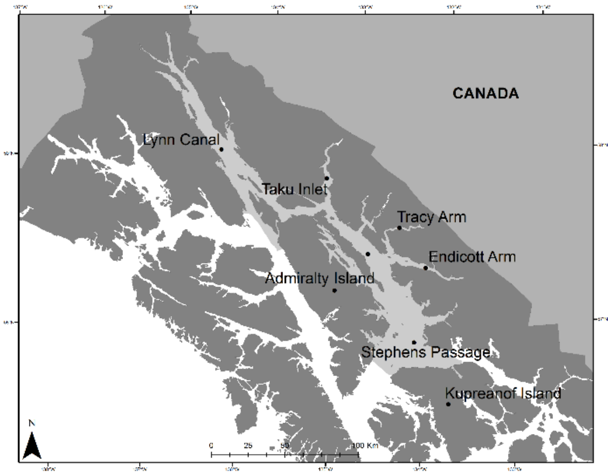


Figure 2i. Approximate distribution of Lynn Canal/Stephens Passage harbor seal stock (shaded area).

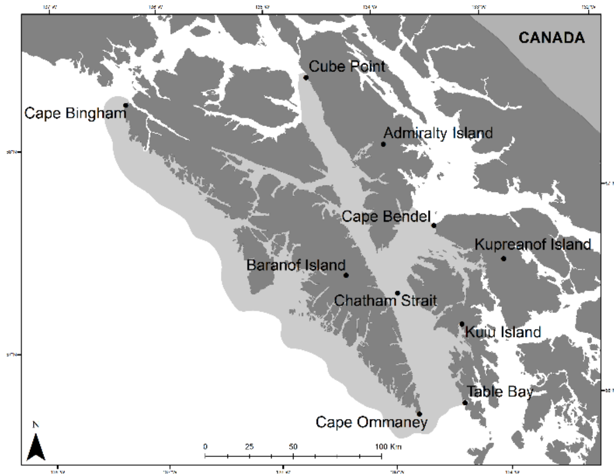
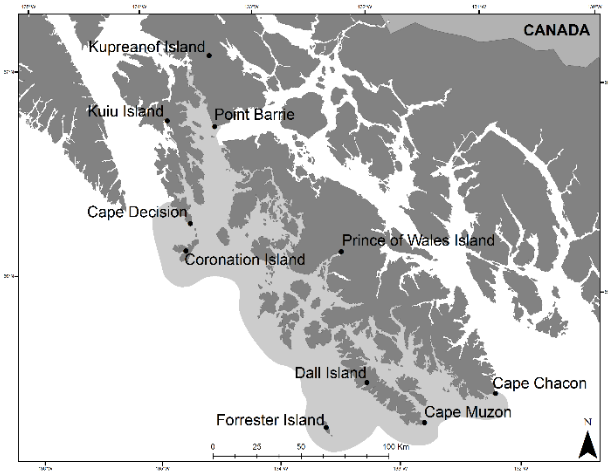


Figure 2j. Approximate distribution of Sitka/Chatham Strait harbor seal stock (shaded area).



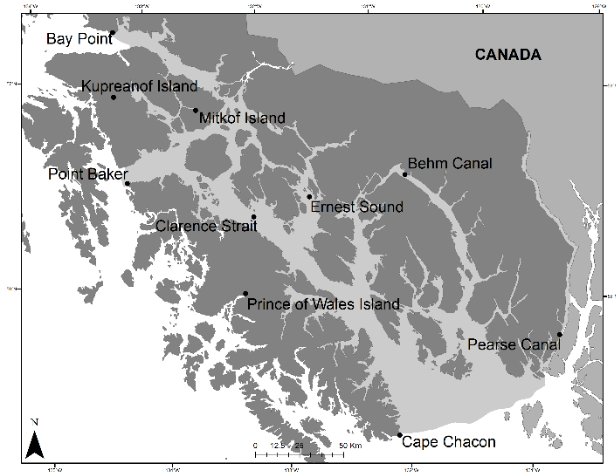


Figure 2k. Approximate distribution of Dixon/Cape Decision harbor seal stock (shaded area).

Figure 2l. Approximate distribution of Clarence Strait harbor seal stock (shaded area).

POPULATION SIZE

The Alaska Fisheries Science Center's National Marine Mammal Laboratory ~~(Alaska Fisheries Science Center)~~ routinely conducts aerial surveys of harbor seals across their entire range in Alaska. Prior to 2008, Alaska was divided into five survey regions, with one region surveyed per year. In 2010, the survey sites were prioritized based on the newly defined harbor seal stock divisions, and annual aerial surveys attempt to ~~cover~~sample the full geographic range of harbor seals in Alaska~~. We~~, with a focus~~ed~~ on ~~surveying~~ sites that make up a significant portion of each stock's population every year~~. Those~~; sites with fewer seals are flown every 3 to 5 years~~, eventually providing~~. This site specific survey approach is designed to provide the ~~data~~counts necessary to estimate ~~harbor seal~~stock specific population abundance and trend~~s~~ for all 12 stocks ~~on an~~ annual~~ basis~~ly. To derive an accurate estimate of population size from these surveys, a method was developed to address the influence of external conditions on the number of seals hauled out on shore, and counted, during the surveys. Many factors influence the propensity of seals to haul out, including tides, time of day, and date in the seals' annual life history cycle. A statistical model defining the relationship between these factors and the number of seals hauled out was developed. Based on those models, the survey counts for each year were adjusted to the number of seals that would have been ashore during a hypothetical survey conducted under ideal conditions for hauling out (Boveng et al. 2003). In a separate analysis of radio-tagged seals, a similar statistical model was used to estimate the proportion of seals that were hauled out under those ideal conditions (Simpkins et al. 2003). The results from these two analyses were combined for each region to estimate the population size of each stock in Alaska.

Abundance Estimates and Minimum Population Estimates

The current statewide abundance estimate for Alaskan harbor seals is ~~152,602 (SE: 7,703)~~205,090 (~~NMFS, unpublished data~~Boveng et al. in prep.), based on aerial survey data collected during 1998-~~2007~~2011. See Table 1 for abundance estimates of the ~~twelve~~12 stocks of harbor seals ~~identified~~ in Alaska. The minimum population estimate (N_{MIN}) for ~~each~~11 of the ~~twelve~~12 stocks of harbor seals ~~identified~~ in Alaska is calculated ~~using~~ as the lower bound of the 80% credible interval obtained from the posterior distribution of abundance estimates. This approach is consistent with the definition of ~~Equation 1 from the~~ potential biological removal (PBR) in the current ~~G~~guidelines (Wade and Angliss 1997)~~: $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{1/2})$~~. The abundance estimate and N_{MIN} for the remaining stock, the Pribilof Islands stock, is simply the number counted in the most recent survey of this very small group.

Table 1. Abundance and ~~minimum population size~~5-year trend estimates ~~of~~, by stock, for harbor seals in Alaska ~~by stock~~, along with respective estimates of standard error. The probability of decrease represents the proportion of the posterior probability distribution for the 5-year trend that fell below a value of 0 seals per year.

Stock	**Year of last survey**	**Abundance estimate**	**SE**	**5-year trend estimate**	**SE**	**Probability of decrease**	**N_{MIN}**
Aleutian Islands	2011	6,431	882	75	220	0.36	5,772
Pribilof Islands	2010	232	n/a	n/a	n/a	n/a	232
Bristol Bay	2011	32,350	6,882	1,209	1,941	0.25	28,146
N. Kodiak	2011	8,321	1,619	531	590	0.16	7,096
S. Kodiak	2011	19,199	2,429	-461	761	0.72	17,479
Prince William Sound	2011	29,889	13,846	26	3,498	0.56	27,936
Cook Inlet/Shelikof Strait	2011	27,386	3,328	313	1,115	0.38	25,651
Glacier Bay/Icy Strait	2011	7,210	1,866	179	438	0.40	5,647
Lynn Canal/Stephens Passage	2011	9,478	1,467	-176	388	0.71	8,605
Sitka/Chatham Strait	2011	14,855	2,106	411	568	0.23	13,212
Dixon/Cape Decision	2011	18,105	1,614	216	360	0.29	16,727
Clarence Strait	2011	31,634	4,518	921	1,246	0.21	29,093

~~**Stock**~~	~~**Year of Last Survey**~~	~~**Abundance Estimate**~~	~~**SE**~~	~~**CV**~~	~~**N_{MIN}**~~
~~Aleutian Islands~~	~~2004~~	~~3,579~~	~~329~~	~~0.092~~	~~3,313~~
~~Pribilof Islands~~	~~2010~~	~~232~~		~~Unavail.~~	~~232~~
~~Bristol Bay~~	~~2005~~	~~18,577~~	~~1,080~~	~~0.058~~	~~17,690~~
~~N. Kodiak~~	~~2006~~	~~4,509~~	~~290~~	~~0.064~~	~~4,272~~
~~S. Kodiak~~	~~2006~~	~~11,117~~	~~573~~	~~0.052~~	~~10,645~~
~~Prince William Sound~~	~~2006~~	~~31,503~~	~~5,599~~	~~0.178~~	~~27,157~~
~~Cook Inlet/Shelikof~~	~~2006~~	~~22,900~~	~~1,221~~	~~0.053~~	~~21,896~~
~~Glacier Bay/Icy Strait~~	~~2007~~	~~5,042~~	~~377~~	~~0.075~~	~~4,735~~
~~Lynn Canal/Stephens~~	~~2007~~	~~8,870~~	~~473~~	~~0.053~~	~~8,481~~
~~Sitka/Chatham~~	~~2007~~	~~8,586~~	~~443~~	~~0.052~~	~~8,222~~
~~Dixon/Cape Decision~~	~~2003~~	~~14,388~~	~~860~~	~~0.060~~	~~13,682~~
~~Clarence Strait~~	~~2003~~	~~23,289~~	~~989~~	~~0.042~~	~~22,471~~

Current Population Trend

Aerial surveys of harbor seal haulout sites throughout Alaska have been conducted annually and provide information on trends in abundance. ~~The following summarizes available information on the population trend for each of the 12 new stocks.~~ The most current estimates of trend (Table 1) were estimated as the means of the slopes of 1,000 simple linear regressions over the most recent eight annual estimates in each of the 1,000 Markov Chain Monte Carlo (MCMC) samples from the posterior distributions for abundance. Thus, they are in units of seals per year, rather than the typical annual percent growth rate. There is no appropriate method for converting these estimates of trend to annual percent growth rate. As a reflection of uncertainty in trend estimates, the proportion of the posterior distribution for each stock's trend that lies below the value of 0 is used as an estimate of the probability that a stock is currently decreasing (Table 1). This allows a probabilistic determination of the qualitative trend status: a value greater than 0.5 means the evidence suggests that the stock is decreasing; less than 0.5 means the stock is increasing. Because there will typically be a 2-3 year lag between the most recent surveys and the Stock Assessment Report update, a 5-year interval was used for estimating trend. This ensures trend estimates are based on data no more than about 8 years old, which is considered to be the approximate threshold of reliability for MMPA stock assessment data. One caveat of this approach is that, due to the skewness inherent in the posterior distribution, it is possible for a stock to exhibit a positive trend while also having a probability of decrease greater than 0.5. The following summarizes historical and recent information on the population trend for each of the 12 stocks.

Aleutian Islands: A partial estimate of harbor seal abundance in the Aleutian Islands was ~~conducted~~determined from ~~a~~ skiff surveys of 106 islands from 1977 to -1982 (8,601 seals). Small et al. (2008) compared counts from the same islands during a 1999 aerial survey (2,859 seals). Counts decreased at a majority of the islands. Islands with greater than 100 seals decreased by 70%. The overall estimates showed a 67% decline during the approximate 20-year period (Small et al. 2008). The current (2007-2011) estimate of the population trend in the Aleutian Islands is ~~unknown.~~+75 seals per year, with a probability that the stock is decreasing of 0.36 (Table 1).

~~Surveying harbor seals in the Aleutian Islands is notoriously difficult. The Aleutian Islands are often blanketed with fog or high winds that limit aerial surveys to narrow windows of time. The logistics of surveying the entire length of the Aleutian Chain are also quite difficult with limited airports and limited access to fuel. Additionally, the haul-out patterns of harbor seals in the Aleutian Islands have not been studied, and there is no stock specific estimate of a survey correction factor. NMFS is committed to conducting surveys on an annual basis within the Aleutian Islands stock and improving our understanding of these behaviors; however, the logistical challenges likely mean longer time periods before adequate assessment of population trends and parameters can be completed.~~

Pribilof Islands: Counts of harbor seals in the Pribilof Islands ranged from 250 to 1,224 in the 1970s. Counts in the 1980s and 1990s ranged between 119 and 232 harbor seals. Prior to July 2010, the most recent count was in 1995 ~~and reported~~when a total ~~count~~ of 202 seals were counted. In July 2010, approximately 185 adults and 27 pups were observed on Otter Island plus approximately 20 on all the other islands combined for a total of 232 harbor seals. Maximum seal counts (all ages) are nearly identical to the 1995 counts (212 vs. 202), but 2010 pup numbers ~~are~~were slightly less (27 vs. 42). The current population trend in the Pribilof Islands is unknown.

Bristol Bay: At Nanvak Bay, ~~(~~the largest haul-out in northern Bristol Bay~~)~~, harbor seals declined in abundance ~~between~~from 1975 to -1990 and increased from 1990 to -2000 (Jemison et al. 2006). Land-based harbor seal counts at Nanvak Bay from 1990 to -2000 increased at 9.2%~~/~~ per year during the pupping period and 2.1% ~~/~~per year during the molting period (Jemison et al. 2006). The Iliamna Lake harbor seal population of about 400 seals, that forms a small portion of the Bristol Bay stock, likely increased through the 1990s and is now stable at around 400 animals (Ver Hoef et al. in prep). ~~Data from the NMFS aerial surveys also show an increasing trend for this stock (NMFS unpublished data).~~The current (2007-2011) estimate of the population trend in the Bristol Bay stock is +1,209 seals per year, with a probability that the stock is decreasing of 0.25 (Table 1).

North Kodiak: ~~Population trend information for~~The current (2007-2011) estimate of the North Kodiak ~~harbor seal~~ population trend is +531 seals per year, with a probability that the stock is ~~not available at this time~~ decreasing of 0.16 (Table 1).

South Kodiak: A significant portion of the harbor seal population within the South Kodiak stock is located at and around Tugidak Island off the southwest coast of Kodiak Island. Sharp declines in the number of seals present on Tugidak were observed between 1976 and 1998. The highest rate of decline was 21% per year between 1976 and 1979 (Pitcher 1990). While the number of seals on Tugidak has stabilized and shown some evidence of increase since the decline, the population in 2000 remained reduced by 80% compared to the levels in the 1970s (Jemison et al. 2006). The current (2007-2011) estimate of the South Kodiak population trend ~~for this~~is -461 seals per year, with a probability that the stock is ~~unknown~~decreasing of 0.72 (Table 1).

Prince William Sound: The Prince William Sound stock includes harbor seals both within and adjacent to Prince William Sound proper. Within Prince William Sound proper, harbor seals declined in abundance by 63% between 1984 and 1997 (Frost et al. 1999). ~~More recent analysis of population abundance (ADFG, unpublished) and trend within Prince William Sound proper indicates the population stabilized around 2002 and has likely been increasing since then.~~ In Aialik Bay, adjacent to Prince William Sound proper, there has been a decline in pup production by

4.6% annually from 40 down to 32 pups born from 1994 to 2009 (Hoover-Miller et al. 2011). ~~Trend information and analysis for the entire Prince William Sound stock is not available at this time.~~ The current (2007–2011) estimate of the Prince William Sound population trend over a 5-year period is +26 seals per year, with a probability that the stock is decreasing of 0.56 (Table 1). As noted earlier, this is an example where the skewed nature of the posterior distribution of the abundance estimate has resulted in a higher than 0.5 probability of decrease while subsequently showing an increasing trend.

Cook Inlet/Shelikof Strait: A multi-year study of seasonal movements and abundance of harbor seals in Cook Inlet was conducted between 2004 and 2007. This study involved multiple aerial surveys throughout the year, and ~~data from this study indicates~~the data indicated a stable population of harbor seals during the August molting period (~~Montgomery et al. 2007~~Boveng et al. 2011). Aerial surveys along the Alaska Peninsula present greater logistical challenges and have therefore been conducted less frequently. The current (2007-2011) estimate of the Cook Inlet/Shelikof Strait population trend is +313 seals per year, with a probability that the~~for the entire~~ stock is ~~unknown~~decreasing of 0.38 (Table 1).

Glacier Bay/Icy Strait: The Glacier Bay/Icy Strait stock show~~s~~ed a negative population trend estimate for harbor seals from 1992 to -2008 in June and August for glacial (-7.7%/yr; -8.2%/yr) and terrestrial sites (-12.4%/yr, August only) (Womble et al. 2010). Trend estimates by Mathews and Pendleton (2006) were similarly negative for both glacial and terrestrial sites. Long-term monitoring of harbor seals on glacial ice has occurred in Glacier Bay since the 1970~~'~~s (~~Hoover 1983, Hoover-Miller 1994,~~ Mathews and Pendleton 2006)~~,~~ and has shown this area to support one of the largest breeding aggregations in Alaska (Steveler 1979, Calambokidis et al. 1987). After a dramatic retreat of Muir Glacier (more than 7 km), in the East Arm of Glacier Bay, between 1973 and 1986 ~~(more than 7 km)~~ and the subsequent grounding and cessation of calving in 1993, floating glacial ice was greatly reduced as a haul-out substrate for harbor seals and ultimately resulted in the abandonment of upper Muir Inlet by harbor seals (Calambokidis et al. 1987, Hall et al. 1995, Mathews 1995)~~,~~. Prior to 1993, seal counts were up to 1,347 in the East Arm of Glacier Bay; 2008 counts were fewer than 200 (Streveler 1979, Molnia 2007). ~~The most recent data through 2008 show a decline of harbor seals in Glacier Bay (Womble et al. 2010) with adjusted mean counts from 2004-2008 less than those for 1992-2002 (Mathews and Pendleton 2006).~~ The current (2007–2011) estimate of the Glacier Bay/Icy Strait population trend is +179 seals per year, with a probability that the stock is decreasing of 0.40 (Table 1).

Lynn Canal/Stephens Passage: The ~~Population trend information for~~current (2007-2011) estimate of the Lynn Canal/Stephens Passage ~~harbor seal~~population trend is -176 seals per year, with a probability that the stock is ~~unknown~~decreasing of 0.71 (Table 1).

Sitka/Chatham Strait: The ~~population trend for~~current (2007-2011) estimate of the Sitka/Chatham Strait ~~harbor seal~~population trend is +411 seals per year, with a probability that the stock is ~~unknown~~decreasing of 0.23 (Table 1).

Dixon/Cape Decision: The ~~Population trend information for~~current (2007-2011) estimate of the Dixon/Cape Decision ~~harbor seal~~ population trend is +216 seals per year, with a probability that the stock is ~~either increasing or stable~~decreasing of 0.29 (Table 1).

Clarence Strait: The ~~population trend for~~current (2007-2011) estimate of the Clarence Strait ~~harbor seal~~ population trend is +921 seals per year, with a probability that the stock is ~~either stable or increasing~~decreasing of 0.21 (Table 1).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Reliable rates of maximum net productivity have not been estimated ~~for~~directly from the ~~twelve~~12 stocks of harbor seals identified in Alaska. ~~Population growth rates were~~Based on monitoring in Washington State from 1978 to 1999, Jeffries et al. (2003) estimated R_{MAX} to be 12.6% and 18.5% for harbor seals of the inland and coastal stocks~~at 6% and 8% between 1991 and 1992 in Oregon and Washington~~, respectively ~~(Huber et al. 1994)~~. Harbor seals have been protected in British Columbia since 1970, and the monitored portion of that population ~~has~~ responded with an annual rate of increase of approximately 12.5% ~~since 1973~~through the late 1980s (Olesiuk et al. 1990)~~. However, until additional data become available from which~~, though a more ~~reliable~~recent evaluation suggested that 11.5% may be a more appropriate figure (DFO 2010). These empirical estimates of ~~population growth can be determined,~~ R_{MAX} indicate~~it is recommended~~ that the continued use of the pinniped maximum theoretical net productivity rate ~~(R_{MAX})~~ of 12% ~~be employed~~is appropriate for ~~these~~the Alaska stocks (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. ~~The recovery factor (F_R) for pinniped stocks with unknown population status is 0.5, whereas a value of 1.0 is used for those stocks with an increasing or stable population trend (Wade and Angliss 1997). Table 2 summarizes the PBR levels for each stock of harbor seals in Alaska based on N_{MIN} estimates and population trend, if known.~~Marine mammal stocks such as the harbor seal stocks in Alaska that are taken by subsistence hunting may be given F_R values up to 1.0, provided they are "known to be increasing" or "not known to be decreasing" and "there have not been recent increases in the levels of takes" (Wade and Angliss 1997). For harbor seals in Alaska, these guidelines were followed by assigning all harbor seal stocks an initial, default recovery factor of 0.5. The default value was adjusted up to 0.7 if the estimated probability of decrease was greater than 0.7. The value was adjusted down to 0.3 if the estimated probability of decrease was less than 0.3. This provides a simple, balanced approach for providing a recovery factor consistent with current guidelines while incorporating results from novel statistical methods. Table 2 summarizes the PBR levels for each stock of harbor seals in Alaska based on N_{MIN} estimates, R_{MAX} = 12%, and F_R values.

Table 2. Potential biological removal (PBR) ~~levels for each~~calculations by stock ~~of~~for harbor seals in Alaska ~~based on~~. The N_{MIN} values are determined from the 20th percentile of the posterior distribution for stock-level abundance estimates, ~~R_{MAX}, and population trend~~except for the Pribilof Islands. A default value of 0.5 was used as the recovery factor ~~of 1.0 was used for stocks with an increasing or stable population, and 0.5 was used for those stocks with unknown population status~~. Based on evaluation of the trend estimates and probability of decrease, the recovery factor for some stocks was increased to 0.7. For other stocks, the recovery factor was decreased to 0.3.

Stock	**N_{MIN}**	**R_{MAX}**	**Recovery Factor (F_R) (default value = 0.5)**	**PBR**
Aleutian Islands	5,772	0.12	0.5	173
Pribilof Islands	232	0.12	0.5	7
Bristol Bay	28,146	0.12	0.7	1,182
N. Kodiak	7,096	0.12	0.7	298
S. Kodiak	17,479	0.12	0.3	314
Prince William Sound	27,936	0.12	0.5	838
Cook Inlet/Shelikof Strait	25,651	0.12	0.5	770
Glacier Bay/Icy Strait	5,647	0.12	0.5	169
Lynn Canal/Stephens Passage	8,605	0.12	0.3	155
Sitka/Chatham Strait	13,212	0.12	0.7	555
Dixon/Cape Decision	16,727	0.12	0.7	703
Clarence Strait	29,093	0.12	0.7	1,222

~~Stock~~	~~N_{MIN}~~	~~R_{MAX}~~	~~Recovery Factor (F_R)~~	~~PBR Calculation ($PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$)~~	~~PBR~~
~~Aleutian Islands~~	~~3,313~~	~~0.12~~	~~0.5~~	~~3,313 x 0.06 x 0.5~~	~~99~~
~~Pribilof Islands~~	~~232~~	~~0.12~~	~~0.5~~	~~232 × 0.06 × 0.5~~	~~7~~
~~Bristol Bay~~	~~17,690~~	~~0.12~~	~~1.0~~	~~17,690 × 0.06 × 1.0~~	~~1,061~~
~~N. Kodiak~~	~~4,272~~	~~0.12~~	~~1.0~~	~~4,272 × 0.06 × 1.0~~	~~256~~
~~S. Kodiak~~	~~10,645~~	~~0.12~~	~~1.0~~	~~10,645 × 0.06 × 1.0~~	~~639~~
~~Prince William Sound~~	~~27,157~~	~~0.12~~	~~0.5~~	~~27,157 × 0.06 × 0.5~~	~~815~~
~~Cook Inlet/Shelikof~~	~~21,896~~	~~0.12~~	~~1.0~~	~~21,896 × 0.06 × 1.0~~	~~1,314~~
~~Glacier Bay/Icy Strait~~	~~4,735~~	~~0.12~~	~~0.5~~	~~4,735× 0.06 × 0.5~~	~~142~~
~~Lynn Canal/Stephens~~	~~8,481~~	~~0.12~~	~~0.5~~	~~8,481 × 0.06 × 0.5~~	~~254~~
~~Sitka/Chatham~~	~~8,222~~	~~0.12~~	~~0.5~~	~~8,222 × 0.06 × 0.5~~	~~247~~
~~Dixon/Cape Decision~~	~~13,682~~	~~0.12~~	~~1.0~~	~~13,682 × 0.06 × 1.0~~	~~821~~
~~Clarence Strait~~	~~22,471~~	~~0.12~~	~~1.0~~	~~22,471 × 0.06 × 1.0~~	~~1,348~~

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Previous stock assessments for harbor seals indicated three observed commercial fisheries operated within the range of the Bering Sea stocks of harbor seals, three within the range of stocks in Southeast Alaska, and five within the range of harbor seal stocks in the Gulf of Alaska. As of 2003, changes in how fisheries are defined in the MMPA List of Fisheries have resulted in separating these fisheries into 14 fisheries in the Bering Sea ~~into 14 fisheries, those~~, 9 fisheries in Southeast Alaska ~~into 9 fisheries~~, and 22 fisheries in the Gulf of Alaska based on both gear type and target species (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska.

~~Observer programs in several fisheries have documented mortalities or serious injuries of harbor seals in the Bering Sea/Aleutian Islands flatfish trawl, the Bering Sea/ Aleutian Islands pollock trawl, and the Bering Sea/Aleutian Islands Pacific cod trawl, as well as in salmon set gillnet (Cook Inlet and Kodiak Island) and salmon drift gillnet (Prince William Sound, Alaska Peninsula/ Aleutian Islands, and Cook Inlet) fisheries. Between 2007-2009, there was one observed mortality of a harbor seal in the Bering Sea/ Aleutian Islands pollock trawl fishery, which is the only observed serious injury or mortality observed in any Alaska groundfish fishery for this 3-year period (NMFS, unpubl. data; Table 3).~~ Observer programs have documented mortality and serious injury of harbor seals in the Bering Sea/Aleutian Islands (BSAI) flatfish trawl fishery (1 in 2011 and 2 in 2012), Gulf of Alaska (GOA) Pacific cod trawl fishery (1 in 2010), and GOA flatfish trawl fishery (1 in 2011 and 2 in 2013) in 2009-2013 (Breiwick 2013; NMML, unpubl. data) (Table 3).

~~The estimated minimum annual mortality rate of harbor seals incidental to commercial groundfish fisheries for the period 2007-2010 is 1.03. However,~~ Although a reliable estimate of the overall mortality and serious injury rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in salmon gillnet fisheries known to interact with several of these stocks~~. Additionally, allocating any reported fishery mortalities to any one particular stock is problematic and the methodology for stock assignment is still under development. Therefore~~, for the purposes of stock assessment, ~~a rate of 1.03 commercial fisheries mortalities~~ mean annual mortality and serious injury rates are assigned to the following harbor seal ~~is used for each~~ stocks based on the location of takes in observed fisheries in 2009-2013 (Table 3): Bristol Bay stock: 0.6 from the BSAI flatfish trawl fishery; South Kodiak stock: 0.6 from the GOA Pacific cod trawl fishery + 1.3 from the GOA flatfish trawl fishery; Cook Inlet/Shelikof Strait stock: 0.4 from the GOA flatfish trawl fishery mortality in 2011 (this seal could have been from either the South Kodiak or Cook Inlet/Shelikof Strait stock, so the mortality is assigned to both stocks).

Table 3. Summary of incidental mortality and serious injury of harbor seals in Alaska due to U.S. commercial fisheries ~~from 2007 through 2010~~in 2009-2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data).

Fishery name	Years	Data type	~~Range of~~Percent observer coverage ~~(%)~~	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
~~Bering Sea/ Aleutian Islands pollock trawl~~	~~2007~~	~~obs data~~	~~85~~	~~0~~	~~0~~	~~0.30 (CV = 0.64)~~
	~~2008~~		~~85~~	~~1~~	~~1.2~~	
	~~2009~~		~~86~~	~~0~~	~~0~~	
	~~2010~~		~~86~~	~~0~~	~~0~~	
Bering Sea/ Aleutian Is.~~lands~~ flatfish trawl	~~2007~~	obs data	~~72~~	~~1~~	~~1.3~~	~~0.31~~0.6 (CV = ~~0.67~~0.02)
	~~2008~~		~~100~~	~~0~~	~~0~~	
	2009		~~100~~99%	0	0	
	2010		~~100~~99%	0	0	
	2011		99%	1	1	
	2012		99%	2	2	
	2013		99%	0	0	
Gulf of Alaska Pacific cod trawl	~~2007~~	obs data	~~17~~	~~0~~	~~0~~	~~0.73~~0.6 (CV = ~~0.82~~0.81)
	~~2008~~		~~15~~	~~0~~	~~0~~	
	2009		29%	0	0	
	2010		31%	1	~~2.9~~2.8	
	2011		41%	0	0	
	2012		25%	0	0	
	2013		11%	0	0	
Gulf of Alaska flatfish trawl	2009	obs data	21%	0	0	1.3 (CV = 0.69)[b]
	2010		26%	0	0	
	2011		31%	1	1.9	
	2012		42%	0	0	
	2013		46%	2[a]	4.7	
Minimum total estimated annual mortality						~~1.34~~2.5 (CV = ~~0.49~~0.41)

[a]Two pinnipeds incidentally caught in 2013 were recently genetically identified as harbor seals.
[b]The CV for this fishery does not accommodate the 2013 data.

Observer programs in Alaska State-managed salmon set gillnet and salmon drift gillnet fisheries have documented harbor seal mortality and serious injury (Table 4). The Prince William Sound salmon drift gillnet fishery is known to interact with harbor seals, although the most recent observer data available for this fishery ~~is~~are from 1990 and 1991. The estimated minimum average annual mortality and serious injury rate (24) in this fishery will be applied to the Prince William Sound stock of harbor seals.~~The estimated minimum annual mortality rate incidental to salmon set and drift gillnet commercial fisheries is 24.0 (Table 4). This estimated annual mortality rate in the Prince William Sound salmon drift gillnet fishery (24.0) is added to the overall annual commercial fishery mortality (1.3) in the overall commercial fisheries mortality estimate (25.3) for the Prince William Sound stock of harbor seals.~~

Table 4. Summary of incidental mortality and serious injury of harbor seals in Alaska due to U.S. commercial salmon drift and set gillnet fisheries from 1990 through 2002 and calculation of the mean annual mortality and serious injury rate based on the most recent observer program data available.

Fishery name	Years	Data type	Percent~~Range of~~ observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Prince William Sound salmon drift gillnet	1990 1991	obs data	4% 5%	2 1	36 12	24 (CV = 0.50)
~~Alaska Peninsula/Aleutian Islands salmon drift gillnet~~	~~90~~	~~obs data~~	~~4%~~	~~0~~	~~0~~	~~0~~
~~Cook Inlet salmon drift gillnet~~	~~1999~~ ~~2000~~	~~obs data~~	~~1.8%~~ ~~3.7%~~	~~0~~ ~~0~~	~~0~~ ~~0~~	~~0~~
~~Cook Inlet salmon set gillnet~~	~~1999~~ ~~2000~~	~~obs data~~	~~7.3%~~ ~~8.3%~~	~~0~~ ~~0~~	~~0~~ ~~0~~	~~0~~
~~Kodiak Island salmon set gillnet~~	~~2002~~	~~obs data~~	~~6.0%~~	~~0~~	~~0~~	~~0~~
~~Observer program total~~						~~24.0~~ ~~(CV = 0.50)~~
Minimum total estimated annual mortality						24~~.0~~ (CV = 0.50)

Reports to the NMFS Alaska Region stranding database of harbor seals entangled in fishing gear or with injuries caused by interactions with gear are another source of mortality and serious injury data (Helker et al. 2015). During 2009-2013, harbor seal mortality and serious injury occurred due to interactions with unknown fisheries (1 Clarence Strait harbor seal was observed with a hook and weight in its mouth in 2010 and 1 Cook Inlet/Shelikof Strait harbor seal entangled in an unknown set net in 2011) and recreational fishing gear (1 Prince William Sound harbor seal was caught in hook and line gear and cut loose with trailing gear in 2009), resulting in mean annual mortality and serious injury rates of 0.2 harbor seals per year from each of these stocks due to fishery-related strandings.

Alaska Native Subsistence/~~Native~~ Harvest Information

The Alaska Native subsistence harvest of harbor seals has been estimated by the Alaska Native Harbor Seal Commission (ANHSC) and the Alaska Department of Fish and Game (ADF&G). ~~Recent i~~Information from the ADF&G indicates the average harvest levels for the 12 stocks of harbor seals identified in Alaska from 2004 to ~~-~~2008, including struck and lost, as follows (see Table 5; average annual ~~take~~harvest column). In 2011 and 2012, data on community subsistence harvests were collected for Kodiak Island, Prince William Sound, and Southeast Alaska (see Table 5; annual harvest 2011-2012 column). ~~As of 2009, data on community subsistence harvests are no longer being collected by ADFG.~~ The remaining stocks have no updated community subsistence data, t~~T~~herefore, the most recent 5-years of data (2004-2008) will be retained and used for estimating annual mortality and serious injury estimates for ~~all areas~~these stocks.

Table 5. Summary of the subsistence harvest data for all 12 harbor seal stocks in Alaska, 2004-2008 and 2011-2012. Data are from (Wolfe et al. ~~2004~~, 2005, 2006, 2008, 2009a, 2009b, 2012, 2013~~Wolfe et al. 2006, Wolfe et al. 2008, Wolfe et al. 2009a, Wolfe et al. 2009b~~).

Stock	Minimum ~~A~~annual ~~H~~harvest 2004-2008	Maximum ~~A~~annual ~~H~~harvest 2004-2008	Average ~~A~~annual ~~H~~harvest 2004-2008	Annual harvest 2011 or 2012
Aleutian Islands	50	146	90	N/A
Pribilof Islands	0	0	0	N/A
Bristol Bay	82	188	141	N/A
N. Kodiak	66	260	131	37
S. Kodiak	46	126	78	126
Prince William Sound	325	600	439	255
Cook Inlet/Shelikof Strait	177	288	233	N/A
Glacier Bay/Icy Strait	22	108	52	104
Lynn Canal/Stephens Passage	17	60	30	50
Sitka/Chatham Strait	97	314	222	77
Dixon/Cape Decision	100	203	157	69
Clarence Strait	71	208	164	40

Other Mortality

Reports to ~~T~~the NMFS Alaska Region stranding database ~~records from 2006 to 2010 document stranded~~of harbor seals entangled in marine debris or with injuries caused by other types of ~~with signs of~~ human interaction are another source of mortality and serious injury data (Helker et al. 2015). ~~During this 5-year period, 6 strandings occurred due to unknown fishery interaction (1 in 2006, 1 in 2007, 2 in 2008, 1 in 2009, and 1 in 2010) and 3 from vessel collision (1 in 2008, 1 in 2009, and 1 in 2010).~~During 2009-2013, one harbor seal (observed towing a buoy in 2011) was determined to be seriously injured due to entanglement in marine debris and one harbor seal mortality due to a ship strike occurred in 2009, 2010, and 2012. The estimated average annual serious injury and mortality ~~estimate~~rates based on these stranding data ~~is~~are ~~1.8~~0.6 Clarence Strait harbor seals (0.2 due to entanglement in marine debris/gear + 0.4 due to ship strikes in 2009 and 2012) and 0.2 Lynn Canal/Stephens Passage harbor seals (due to a ship strike in 2010) ~~over the 5 year period from 2006-2010~~for 2009 to 2013. ~~Stock assignment for these mortalities have not been made; therefore, the conservative approach of applying the 1.8 average annual mortality will be attributed to all stocks will be used.~~ An additional average annual mortality and serious injury rate of 0.2 will be applied to the Prince William Sound stock for a harbor seal entanglement, observed (with a remotely operated vehicle) in the salmon seine net of a sunken fishing vessel in Prince William Sound in 2011, that was reported to the NMFS Alaska Region (Helker et al. 2015). Mortality~~ies~~ and serious injury may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 2003 and ~~-~~2007, there ~~were~~was no mortality~~ies~~ or serious injury resulting from research on ~~the Bering Sea~~any stock of harbor seals in Alaska (~~Tammy Adams,~~ Division of Permits~~,~~ and Conservation~~, and Education Division~~, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910).

STATUS OF STOCK

~~Harbor seals are not~~No harbor seal stocks in Alaska are designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the ~~Endangered Species Act~~ESA, and human-caused mortality does not exceed PBR for any of the stocks; therefore, none of the stocks are strategic. At present, average annual mortality and serious injury levels incidental to U.S. commercial fisheries~~y-related annual mortality levels~~ that are less than 10% of PBR can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. The status of all 12 stocks of harbor ~~harbor~~ seals identified in Alaska relative to their Optimum Sustainable Population ~~size~~ is unknown.

Aleutian Islands: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~9.9~~17 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~0 (commercial fisheries) + 90 (harvest) + ~~1.8~~0 (other fishery + other mortality) = ~~93.1~~90) is not known to exceed the PBR (~~99~~173). ~~Therefore, t~~The Aleutian Islands stock of harbor seals is not classified as a strategic stock.

Pribilof Islands: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than 0.7 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~0 + 0 + ~~1.8~~0 = ~~3.1~~0) is not known to exceed the PBR (7). ~~Therefore, t~~The Pribilof Islands stock of harbor seals is not classified as a strategic stock.

Bristol Bay: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~106.1~~118 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~0.6 + 141 + ~~1.8~~0 = ~~144.1~~142) is not known to exceed the PBR (~~1061~~1,182). ~~Therefore, t~~The Bristol Bay stock of harbor seals is not classified as a strategic stock.

North Kodiak: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~25.6~~30 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~0 + ~~131~~37 + ~~1.8~~0 = ~~134.1~~37) is not known to exceed the PBR (~~256~~298). ~~Therefore, t~~The North Kodiak stock of harbor seals is not classified as a strategic stock.

South Kodiak: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~63.9~~32 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~1.9 + ~~78~~126 + ~~1.8~~0 = ~~81.1~~128) is not known to exceed the PBR (~~639~~315). ~~Therefore, t~~The South Kodiak stock of harbor seals is not classified as a strategic stock.

Prince William Sound: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~81.5~~84 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~25.3~~24 + ~~439~~255 + ~~1.8~~0.4 = ~~466.1~~279) is not known to exceed the PBR (~~815~~838). ~~Therefore, t~~The Prince William Sound stock of harbor seals is not classified as a strategic stock.

Cook Inlet/Shelikof Strait: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~131.4~~77 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~0.4 + 233 + ~~1.8~~0.2 = ~~236.1~~234) is not known to exceed the PBR (~~1314~~770). ~~Therefore, t~~The Bristol Bay stock of harbor seals is not classified as a strategic stock.

Glacier Bay/Icy Strait: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~14.2~~17 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~0 + ~~52~~104 + ~~1.8~~0 = ~~55.1~~104) is not known to exceed the PBR (~~142~~169). ~~Therefore, t~~The Glacier Bay/Icy Strait stock of harbor seals is not classified as a strategic stock.

Lynn Canal/Stephens Passage: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~25.4~~16 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~0 + ~~30~~50 + ~~1.8~~0.2 = ~~33.1~~50) is not known to exceed the PBR (~~254~~155). ~~Therefore, t~~The Lynn Canal/Stephens Passage stock of harbor seals is not classified as a strategic stock.

Sitka/Chatham Strait: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~24.7~~56 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~0 + ~~222~~77 + ~~1.8~~0 = ~~225.1~~77) is not known to exceed the PBR (~~247~~555). ~~Therefore, t~~The Sitka/Chatham Strait stock of harbor seals is not classified as a strategic stock.

Dixon/Cape Decision: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~82.1~~70 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~0 + ~~157~~69 + ~~1.8~~0 = ~~160.1~~69) is not known to exceed the PBR (~~821~~703). ~~Therefore, t~~The Dixon/Cape Decision stock of harbor seals is not classified as a strategic stock.

Clarence Strait: ~~Harbor seals are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act.~~ At present, U.S. commercial fishery-related annual mortality and serious injury levels less than ~~134.8~~122 animals per year (i.e., 10% of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. A reliable estimate of the annual rate of mortality and serious injury incidental to commercial fisheries is unavailable. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate due to commercial fishing is insignificant. Based on the best scientific information available, the estimated level of human-caused mortality and serious injury (~~1.3~~0 + ~~164~~40 + ~~1.8~~0.8 = ~~167.1~~41) is not known to exceed the PBR (~~1,348~~1,222). ~~Therefore, t~~The Clarence Strait stock of harbor seals is not classified as a strategic stock.

HABITAT CONCERNS

Glacial fjords in Alaska are critical for harbor seal whelping, nursing and molting. Several of these areas have experienced a ten-fold increase in tour ship visitation since the 1980s. This increase in the presence of tour vessels has resulted in additional levels of disturbance to pups and adults (Jansen et al 2015). The level of serious injury or mortality resulting from increased disturbance is not known.

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BEARDED SEAL (*Erignathus barbatus nauticus*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bearded seals are a boreoarctic species with a circumpolar distribution (Fedoseev 1965~~,~~; Johnson et al. 1966~~,~~; Burns 1967, 1981; Burns and Frost 1979~~, Burns 1981,~~; Smith 1981~~,~~; Kelly 1988). Their normal range extends from the Arctic Ocean (85°N) south to Sakhalin Island (45°N) in the Pacific, and south to Hudson Bay (55°N) in the Atlantic (Allen 1880, Ognev 1935, King 1983). Bearded seals inhabit the seasonally ice-covered seas of the Northern Hemisphere where they whelp and rear their pups, and molt their coats on the ice in the spring and early summer. Bearded seals feed primarily on benthic organisms, including epifaunal and infaunal invertebrates, and demersal fishes and so are closely linked to areas where the seafloor is shallow (less than 200 m).

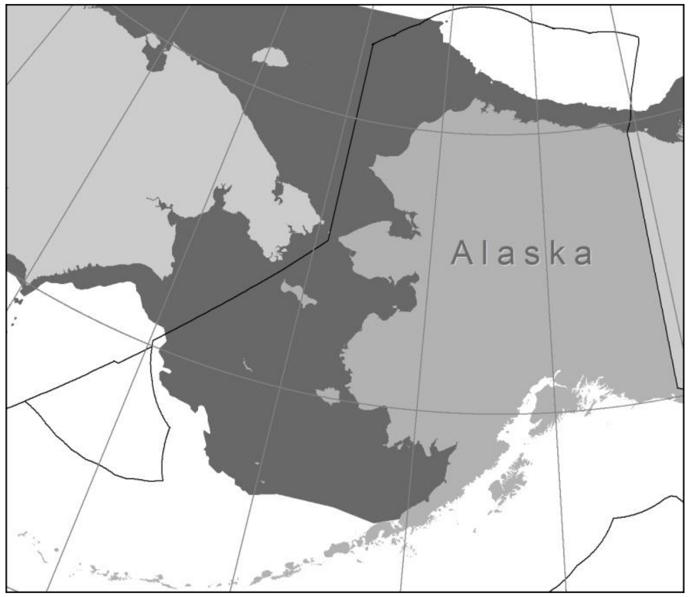

Figure 1. Approximate distribution of bearded seals (dark shaded area) in Alaska. The combined summer and winter distribution are depicted.

Two subspecies have been described: *E. b. barbatus* from the Laptev Sea, Barents Sea, North Atlantic Ocean, and Hudson Bay (Rice 1998); and *E. b. nauticus* from the remaining portions of the Arctic Ocean and the Bering and Okhotsk Seas (Ognev 1935, Scheffer 1958, Manning 1974, Heptner et al. 1976). The geographic distributions of these subspecies are not separated by conspicuous gaps, and there are regions of intergrading generally described as somewhere along the northern Russian and central Canadian coasts. As part of a status review of the bearded seal for consideration of listing as threatened or endangered, Cameron et al. (2010) defined longitude ~~112°W~~ 145°E as the Eurasian delineation between the two subspecies and 112°W in the Canadian Arctic Archipelago as the North American delineation between the two subspecies~~ and 145°E as the Eurasian delineation between the two subspecies~~. Based on evidence for discreteness and ecological uniqueness of bearded seals in the Sea of Okhotsk, the *E. b. nauticus* subspecies was further divided into an Okhotsk Distinct Population Segment (DPS) and a Beringia DPS, so named because the continental shelf waters of the Bering, Chukchi, Beaufort, and East Siberian Seas that are the bearded seals' range in this region overlie much of the land bridge that was exposed during the last glaciation and that has been referred to as Beringia. For the purposes of this stock assessment the Beringia DPS is considered the Alaska ~~S~~stock of the bearded seal (Fig. 1).

Spring surveys conducted in 1999 and 2000 along the Alaskan coast indicate that bearded seals ~~tend to prefer areas of between 70% and 90% sea ice coverage, and~~ are typically more abundant 20-100 nmi from shore than within 20 nmi of shore, with the exception of high concentrations nearshore to the south of Kivalina (Bengtson et al. 2000, ~~Bengtson et al.~~ 2005; Simpkins et al. 2003). Many of the seals that winter in the Bering Sea move north through the Bering Strait from late April through June~~,~~ and spend the summer ~~along the ice edge~~ in the Chukchi Sea (Burns 1967, ~~Burns~~ 1981)~~, although aerial surveys and tagging data suggest they spend time in open water with the loss of ice edge in the Chukchi in summer months~~. Bearded seal sounds (produced by adult males) have been recorded nearly year-round (peak occurrence from December to June when sea ice concentrations were >50%) at multiple locations in the Bering, Chukchi, and Beaufort Seas, and calling behavior is closely related to the presence of sea ice (MacIntyre et al. 2013, in press). The overall summer distribution is quite broad, with seals rarely hauled out on land, and some seals, mostly juveniles, may not follow the ice northward but remain near the coasts of the Bering and Chukchi Seas (Burns 1967, 1981; Heptner et al. 1976~~, Burns 1981,~~; Nelson 1981). As the ice forms again in the fall and winter, most seals move south with the advancing ice edge through the Bering Strait into the Bering Sea where they spend the winter (Burns and Frost 1979;~~,~~ Frost et al. 2005, 2008; Cameron and Boveng 2007, ~~Frost et al. 2008, Cameron and Boveng~~ 2009). This southward migration is less noticeable and predictable than the northward movements in late spring and early summer (Burns and Frost 1979, Burns 1981, Kelly 1988). During winter, the central and northern parts of the Bering Sea shelf have the highest densities of bearded seals (Fay 1974, Heptner et al. 1976, Burns and Frost 1979, Braham et al. 1981, Burns 1981, Nelson et al. 1984). In late winter and early spring, bearded seals are widely but not uniformly distributed in the broken, drifting pack ice ranging from the Chukchi Sea south to the ice front in the Bering Sea. In these areas, they tend to avoid the coasts and areas of fast ice (Burns 1967, Burns and Frost 1979).

POPULATION SIZE

A reliable population estimate for ~~this~~the entire stock is ~~currently considered~~ not available, but research programs have recently developed new survey methods and partial, but useful, abundance estimates. ~~A few regions have been surveyed by various techniques over the past four decades, although only crude estimates for these areas exist and many assumptions used to derive these estimates are conservative (e.g., seals in the water were often not included, some areas were not surveyed or were omitted from the analysis). However, based on studies by Ver Hoef et al. (2010), Fedoseev (2000) and Bengtson et al. (2005), for purposes of the ESA status review of the species, Cameron et al. (2010) estimated about 125,000 bearded seals in the Bering Sea and 27,000 bearded seals in the Chukchi Sea. Cameron et al. (2010) did not present population estimates for the East Siberian and Beaufort Seas, but did estimate that the Beringia DPS contained approximately 155,000 bearded seals. This number is considered a crude estimate based on multiple surveys using various techniques over the past four decades, which involved conservative assumptions. However, given that these numbers are outdated, this estimate cannot necessarily be considered strictly minimum or conservative overall (Cameron et al. 2010). Ver Hoef et al. (2014) calculated an abundance of 61,800 (95% CI 34,900-171,600) bearded seals in a core area (297,880 km²) of the central and eastern Bering Sea using survey data collected from helicopters operating off of an ice breaker in 2007. U.S. and Russian researchers conducted comprehensive and synoptic aerial abundance and distribution surveys of ice-associated seals in the Bering and Okhotsk Seas in 2012 and 2013. Those data are currently being analyzed to provide abundance estimates for bearded seals (Moreland et al. 2013). Conn et al. (2014) reported a preliminary estimate of 299,174 (95% CI 245,476–360,544) bearded seals in the Bering Sea using data from a more extensive, fixed-wing survey (767,000 km²) conducted in April and May of 2012 and 2013; however, these data are still being further analyzed.~~ In spring of 2012 and 2013, U.S. and Russian researchers conducted aerial abundance and distribution surveys of the entire Bering Sea and Sea of Okhotsk (Moreland et al. 2013). The data from these image-based surveys are still being analyzed, but Conn et al. (2014), using a very limited sub-sample of the data collected from the U.S. portion of the Bering Sea in 2012, calculated an abundance estimate of approximately 299,174 (95% CI: 245,476-360,544) bearded seals in those waters. These data do not include bearded seals in the Chukchi and Beaufort Seas~~, and so may have provided a low-biased estimate of the abundance of this DPS~~. ~~The differences in abundance estimates from 2007 (Ver Hoef et al. 2014) and 2012 (Conn et al. 2014) are likely attributable to differences in area sampled and refinement of abundance estimates over time. Further analysis of these data is pending.~~

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for a stock is calculated using Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{1/2})$. A reliable N_{MIN} for the entire stock cannot presently be determined because current reliable estimates of abundance are not available for the Chukchi and Beaufort Seas. Using the 2012 Bering Sea abundance estimate by Conn et al. (2014), however, provides a partial N_{MIN} of 273,676 bearded seals in the U.S. sector of the Bering Sea.~~A reliable minimum population estimate (N_{MIN}) for this stock can not presently be determined because current reliable estimates of abundance are not available. Data from the 2012 and 2013 surveys are currently being analyzed to provide abundance and minimum population estimates for bearded seals (Moreland et al. 2013).~~

Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of bearded seals are unavailable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of bearded seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the ~~potential biological removal (~~PBR~~)~~ is defined as the product of the minimum population estimate (N_{MIN}), one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). Using the partial N_{MIN} calculated for bearded seals in the Bering Sea, a partial PBR for bearded seals that overwinter and breed in the U.S. portion of the Bering Sea = 8,210 (273,676 × 0.06 × 0.5). However, because a reliable estimate of minimum abundance N_{MIN} is currently not available for the entire stock (i.e., N_{MIN} is not available for the Chukchi or Beaufort Seas), the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~New Serious Injury Guidelines~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Of the 22 federally regulated commercial fisheries in Alaska monitored for incidental mortality and serious injury by fisheries observers, 12 fisheries could potentially interact with bearded seals. Between ~~2008 and 2012~~2009 and 2013~~, there were~~ incidental serious injury~~ies~~ and mortality~~ies~~ of bearded seals occurred in ~~two~~three of these fisheries: the Bering Sea/Aleutian Islands pollock trawl, ~~and the~~ Bering Sea/Aleutian Islands flatfish trawl, and Bering Sea/Aleutian Islands Pacific cod trawl fisheries (Table 1). The estimated ~~minimum~~mean annual mortality and serious injury rate incidental to U.S. commercial fisheries is ~~1.8~~1.2 ~~(CV = 0.05)~~ bearded seals per year, based exclusively on observer data.

Table 1. Summary of incidental mortality and serious injury of the Alaska stock of bearded seals ~~(Alaska stock)~~ due to U.S. commercial fisheries from ~~2008 to 2012~~2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). ~~Details of how~~Methods for calculating percent observer coverage ~~is measured are included~~are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Bering Sea/Aleutian Is. pollock trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~85~~ 86% 86% 98% 98% 97%	~~4~~ 1 0 (+1)~~*~~[a] 0 1 0	~~4.1~~ 1.0 0 (+1)~~**~~[b] 0 1.0 0	~~1.23~~0.6 (CV = ~~0.07~~N/A)
Bering Sea/Aleutian Is.~~lands~~ flatfish trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~100~~ ~~100~~99% ~~100~~99% ~~100~~99% ~~100~~99% 99%	~~1~~ 0 0 1 1 0	~~1.0~~ 0 0 1.0 1.0 0	~~0.6~~0.4 (CV = ~~0.02~~0.03)

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Bering Sea/Aleutian Is. Pacific cod trawl	2009 2010 2011 2012 2013	obs data	63% 66% 60% 68% 80%	0 0 0 0 1	0 0 0 0 1	0.2 (CV = 0)
Total estimated annual mortality						~~1.83~~1.2 (CV = ~~0.05~~ 0.03)

~~*~~[a]Total mortality~~ies~~ and serious injury observed in 2010: 0 in sampled hauls + 1 in an unsampled haul~~s~~.
~~**~~[b]~~Total mortalities observed in sampled and unsampled hauls.~~ Since the total known mortality and serious injury (0 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (0) for the fishery in 2010, the ~~sum of actual mortalities~~ observed mortality and serious injury (~~1~~in sampled + unsampled hauls) will be used as a minimum estimate for that year.

Alaska Native Subsistence/~~Native~~ Harvest Information

~~Bearded seals are an important resource for Alaska subsistence hunters, with estimated annual harvests of 1,784 (SD = 941) from 1966 to 1977 (Burns 1981). Between August 1985 and June 1986, 791 bearded seals were harvested in five villages in the Bering Strait region based on reports from the Alaska Eskimo Walrus Commission (Kelly 1988). Five Alaska Native communities in the Northwest Arctic region of Alaska voluntarily reported a total of 258 bearded seals were harvested during 2012 (Ice Seal Committee 2013).~~

~~The Division of Subsistence, Alaska Department of Fish and Game maintained a database that provides additional information on the subsistence harvest of ice seals in different regions of Alaska (ADFG 2000a, b). Information on subsistence harvest of bearded seals was compiled for 129 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarbrough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990 to 1998 were used. As of August 2000, the subsistence harvest database indicated that the estimated number of bearded seals harvested for subsistence use per year was 6,788. Data on overall statewide community subsistence harvests are no longer being collected and no new annual statewide harvest estimates exist.~~

~~At this time, there are no efforts to quantify the total statewide level of harvest of bearded seals by all Alaska communities. A report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 6,788 bearded seals estimated by the ADFG Division of Subsistence is considerably higher than the previous minimum estimate of 791 per year from five villages in the Bering Strait and the recent report of 258 seals harvested during 2012 by five northwest Alaska Native communities. Although some of the more recent entries in the ADFG database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 6,788 bearded seals from 2000 is the best estimate of the total statewide annual harvest level currently available.~~

Bearded seals are an important resource for Alaska Native subsistence hunters. Approximately 64 Alaska Native communities in western and northern Alaska, from Bristol Bay to Kaktovik, regularly harvest ice seals (Ice Seal Committee 2014). The Ice Seal Committee, as co-managers with NMFS, recognizes the importance of harvest information and has been collecting it since 2008 as funding and available personnel have allowed. Annual household survey results are compiled in a statewide harvest report that includes historical ice seal harvest information back to 1960. This report is used to determine where and how often harvest information has been collected and where efforts need to be focused in the future (Ice Seal Committee 2014). Current information, within the last 5 years, is available for 11 communities (Kivalina, Noatak, Buckland, Deering, Emmonak, Scammon Bay, Hooper Bay, Tununak, Quinhagak, Togiak, and Twin Hills) (Table 2); but more than 50 other communities harvest bearded seals and have not been surveyed in the last 5 years or have never been surveyed. Harvest surveys are designed to confidently estimate harvest within the surveyed community, but because of differences in seal availability, cultural hunting practices, and environmental conditions, extrapolating harvest numbers beyond that community is misleading. For example, during the past 5 years (2009-2013), only 11 of the 64 coastal communities have been surveyed for bearded seals and of those only 6 have been surveyed for two or more consecutive years (Ice Seal Committee 2015). Based on the harvest data from these 11 communities (Table 2), a minimum estimate of the average annual harvest of bearded seals in 2009-2013 is 379 seals per year. The Ice Seal Committee is working toward a better understanding of ice seal harvest by conducting more consecutive surveys with the goal of being able to report a statewide ice seal harvest estimate in the future.

Table 2. Bearded seal harvest estimates from 2009 to 2013 and the Alaska Native population for each community (Ice Seal Committee 2015).

Community	**Alaska Native population (2013)**	**Estimated bearded seal harvest**				
		2009	**2010**	**2011**	**2012**	**2013**
Kivalina	352			123		
Noatak	514			65		
Buckland	519			47		
Deering	176			49		
Emmonak	782			106		
Scammon Bay	498			82	51	
Hooper Bay	1,144	332	148	210	212	171
Tununak	342	21	40	42	44	
Quinhagak	694		29	26	44	49
Togiak	842	0	0	2		
Twin Hills	66	0	0			
Total		353	217	752	351	220

Other Mortality

Mortality~~ies~~ and serious injury may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 2007 and 2011, ~~there was 1~~one mortality resulted~~ing~~ from research on the Alaska stock of bearded seals (in 2007), which results in an average annual mortality and serious injury rate of 0.2 ~~mortalities~~bearded seals per year from this stock (~~T. Adams,~~ Division of Permits~~,~~ and Conservation~~, and Education Division~~, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910, 11 January 2012).

Beginning in mid-July 2011, elevated numbers of sick or dead seals, primarily ringed seals, with skin lesions were discovered in the Arctic and Bering Strait regions of Alaska. By December 2011, there were more than 100 cases of affected pinnipeds, including ringed seals, spotted seals, walrus, and a few bearded seals, in northern and western Alaska. Due to the unusual number of marine mammals discovered with similar symptoms across a wide geographic area, NOAA and USFWS declared a Northern Pinniped Unusual Mortality Event (UME) on December 20, 2011. Disease surveillance efforts in 2012-2013 did not detect any new cases similar to those observed in 2011, but the UME investigation remains open for ice seals based on continuing reports in 2013 and 2014 of ice seals in the Bering Strait region with patchy hair loss. To date, no specific cause for the disease has been identified (http://www.alaskafisheries.noaa.gov/protectedresources/seals/ice/diseased).

STATUS OF STOCK

~~On December 28, 2012, NMFS listed the Beringia DPS and, thus, the Alaska Stock, of bearded seals as "threatened" under the Endangered Species Act (ESA) (77 FR 76740).~~ The primary concern for this population is the ongoing and projected loss of sea-ice cover stemming from climate change, which is expected to pose a significant threat to the persistence of these seals in the foreseeable future (based on projections through the end of the 21st century). On December 28, 2012, NMFS listed the Beringia DPS and, thus, the Alaska Stock of bearded seals, as "threatened" under the Endangered Species Act (ESA) (77 FR 76740). Because of its threatened status under the ESA, this stock is designated as "depleted" under the MMPA~~. As a result, the stock is~~ and is classified as a strategic stock. On July 25, 2014, the U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of bearded seals under the ESA (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB). The decision vacated NMFS' listing of the Beringia DPS of bearded seals as a threatened species. On September 25, 2014, the Department of Justice, on behalf of NOAA Fisheries, filed a notice of appeal of this court decision. Because the PBR for the entire stock is unknown, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. A partial PBR for only those bearded seals that overwinter and breed in the U.S. portion of the Bering Sea, however, is 8,210. The total estimated annual level of human-caused mortality and serious injury based on commercial fisheries observer data (~~1.8~~1.2), the most recent MMPA permit records (0.2), and a minimum estimate of the Alaska Native harvest (~~6,788~~379) is ~~6,790~~380 bearded seals. Population trends and status of this stock relative to its Optimum Sustainable Population are currently unknown. Bearded seals remain classified as a strategic stock as a result of their listing under the ESA.

~~Habitat Concerns~~HABITAT CONCERNS

The main concern about the conservation status of bearded seals stems from the likelihood that their sea-ice habitat has been modified by the warming climate and, more so, that the scientific projections are for continued and perhaps accelerated warming in the foreseeable future (Cameron et al. 2010). For bearded seals, the presence of sea ice is considered a requirement for whelping and nursing young. Similarly, the molt is believed to be promoted by elevated skin temperatures that, in polar regions, can only be achieved when seals haul out of the water. Thus, if suitable ice cover is absent from shallow feeding areas during times of peak whelping and nursing (April/May), or molting (May/June and sometimes through August), bearded seals would be forced to seek either sea-ice habitat over deeper waters (perhaps with poor access to food) or coastal regions in the vicinity of haul-out sites on shore (perhaps with increased risks of disturbance, predation, and competition). Both scenarios would require bearded seals to adapt to novel (i.e., potentially suboptimal) conditions, and to exploit habitats to which they may not be well adapted, likely compromising their reproduction and survival rates. A reliable assessment of the future conservation status of each bearded seal species segment requires a focus on projections of specific regional conditions, especially sea ice. End of century projections for the Bering Sea in April-May suggest that there will be sufficient ice only in small zones of the Gulf of Anadyr and in the area between St. Lawrence Island and the Bering Strait. In June in the Bering Sea, suitable ice is predicted to disappear as early as mid-century. To adapt to this regime, bearded seals would likely have to shift their nursing, rearing, and molting areas to the ice-covered seas north of the Bering Strait. Laidre et al. (2008) also concluded that on a worldwide basis bearded seals were likely to be highly sensitive to climate change based on an analysis of various life history features that could be affected by climate.

A second major concern, driven primarily by the production of carbon dioxide (CO_2) emissions, is the modification of habitat by ocean acidification, which may alter prey populations and other important aspects of the marine ecosystem. Ocean acidification, a result of increased carbon dioxide in the atmosphere, may impact bearded seal survival and recruitment through disruption of trophic regimes that are dependent on calcifying organisms. The nature and timing of such impacts are extremely uncertain. Changes in bearded seal prey, anticipated in response to ocean warming and loss of sea ice, have the potential for negative impacts, but the possibilities are complex. Ecosystem responses may have very long lags as they propagate through trophic webs. Because of bearded seals' apparent dietary flexibility, this threat may be of less immediate concern than the threats from sea-ice degradation.

Additional habitat concerns include the potential effects from increased shipping (particularly in the Bering Strait), and oil and gas exploration activities~~,~~ (particularly in the outer continental shelf leasing areas), such as disturbance from vessel traffic, seismic exploration noise, or the potential for oil spills.

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RINGED SEAL (*Phoca hispida hispida*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

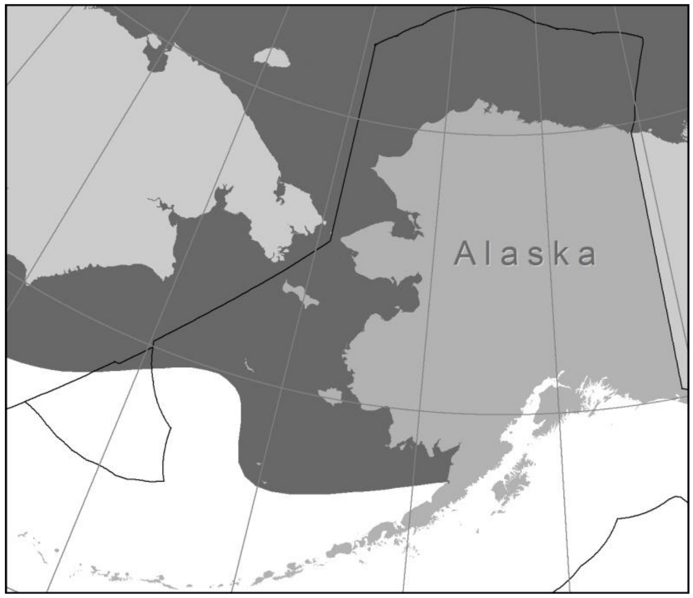

Figure 1. Approximate distribution of ringed seals (dark shaded area). The combined summer and winter distribution are depicted.

Ringed seals have a circumpolar distribution and are found in all seasonally ice-covered seas of the Northern Hemisphere as well as in certain freshwater lakes (King 1983). Most taxonomists currently recognize five subspecies of ringed seals: *Phoca hispida hispida* in the Arctic Ocean and Bering Sea; *Phoca hispida ochotensis* in the Sea of Okhotsk and northern Sea of Japan; *Phoca hispida botnica* in the northern Baltic Sea; *Phoca hispida lagodensis* in Lake Ladoga, Russia; and *Phoca hispida saimensis* in Lake Saimaa, Finland. Morphologically, the Baltic and Okhotsk subspecies are fairly well differentiated from the Arctic subspecies (Ognev 1935, Müller-Wille 1969, Rice 1998) and the Ladoga and Saimaa subspecies differ significantly from each other and from the Baltic subspecies (Müller-Wille 1969, Hyvärinen and Nieminen 1990, Amano et al. 2002). Genetic analyses support isolation of the lake-inhabiting populations (Palo 2003, Palo et al. 2003, Valtonen et al. 2012) but suggest gene flow from the Arctic to the Baltic as well as widespread mixing within the Arctic (Palo et al. 2001, Davis et al. 2008, Kelly et al. 2009, Martinez-Bakker et al. 2013). Differences in body size, morphology, growth rates, or diet between ringed seals in shorefast versus pack ice have been taken as evidence of separate breeding populations in some locations (McLaren 1958, Fedoseev 1975, Finley et al. 1983); however, this has not been thoroughly examined and the taxonomic status of the Arctic subspecies remains unresolved (Berta and Churchill 2012). For the purposes of this stock assessment, the Alaska stock of ringed seals is considered the portion of *Phoca hispida hispida* that occurs within the U.S. Exclusive Economic Zone (EEZ) of the Beaufort, Chukchi, and Bering Seas (Fig. 1).

Throughout their range, ringed seals have an affinity for ice-covered waters and are well adapted to occupying both shorefast and pack ice (Kelly 1988a). They remain in contact with ice most of the year and use it as a platform for pupping and nursing in late winter to early spring, for molting in late spring to early summer, and for resting at other times of the year~~, although land haulouts may be increasingly used because of increases in summer sea ice retreat~~. This species rarely comes ashore in the Arctic; however, in more southerly portions of its range where sea or lake ice is absent during summer and fall, ringed seals are known to use isolated haul-out sites on land for molting and resting (Härkönen et al. 1998, Trukhin 2000, Kunnasranta 2001, Lukin et al. 2006). In Alaskan waters, during winter and early spring when sea ice is at its maximal extent, ringed seals are abundant in the northern Bering Sea, Norton and Kotzebue Sounds, and throughout the Chukchi and Beaufort Seas. They occur as far south as Bristol Bay in years of extensive ice coverage but generally are not abundant south of Norton Sound except in nearshore areas (Frost 1985). Although details of their seasonal movements have not been adequately documented, it is thought that most ringed seals that winter in the Bering and Chukchi Seas migrate north in spring as the seasonal ice melts and retreats (Burns 1970) and spend summer in the pack ice of the northern Chukchi and Beaufort ~~s~~Seas, as well as in nearshore ice remnants in the Beaufort Sea (Frost 1985). During summer, ringed seals range hundreds to thousands of kilometers to forage along ice edges or in highly productive open-water areas (Freitas et al. 2008, Kelly et al. 2010b). With the onset of freeze-up in the fall, ringed seal movements become increasingly restricted and seals that have summered in the Beaufort Sea are thought to move west and south with the advancing ice pack, with many seals dispersing throughout the Chukchi and Bering Seas while some remain in the Beaufort Sea (Frost and Lowry 1984, Crawford et al. 2012, Harwood et al. 2012). Many adult ringed seals return to the same small home ranges they occupied during the previous winter (Kelly et al. 2010b).

POPULATION SIZE

Ringed seal population surveys in Alaska have used various methods and assumptions, had incomplete coverage of their habitats and range, and were conducted more than a decade ago; therefore, current, comprehensive, and reliable abundance estimates or trends for the Alaska stock are not available. Burns and Harbo (1972) conducted aerial surveys along the North Slope of Alaska (between Point Lay and Kaktovik) during June 1970, and reported a minimal estimate of 11,612 ringed seals in areas of shorefast ice. Frost and Lowry (1984) produced a rough estimate of 40,000 ringed seals in the Alaskan Beaufort Sea during winter and spring by applying an assumed correction factor for availability bias (i.e., for seals not hauled out at the time of the surveys) to the average density observed from 7 years of aerial surveys in the Alaskan and Yukon Beaufort Sea and extrapolating over the entire area of the continental shelf. Their estimate during summer of 80,000 ringed seals was based on the assumption that this population doubles as seals from the Bering and Chukchi Seas move in with the receding ice edge. Based on an analysis of surveys conducted during the 1970s, Frost (1985) estimated 1 to 1.5 million ringed seals in Alaskan waters, of which 250,000 were estimated in shorefast ice. These estimates were considered conservative when compared with polar bear predation rates (Frost 1985); however, details of the analysis were not published. Frost et al. (1988) reported detailed methods and results of surveys conducted in the Alaskan Chukchi and Beaufort Seas during May-June 1985-1987. Survey effort was directed towards shorefast ice within 20 nmi of shore, though some areas of adjacent pack ice were also surveyed, and estimates were based on observed densities extrapolated over estimates of available habitat without correcting for availability bias. In the Chukchi Sea, total numbers of hauled out ringed seals in shorefast ice ranged from 18,400 ± 1,700 in 1985 to 35,000 ± 3,000 in 1986. The 1987 estimate of 20,200 ± 2,300 was similar to 1985. In the Beaufort Sea, the estimated number of ringed seals hauled out within the 20-m depth contour ranged from 9,800 ± 1,800 in 1985 to 13,000 ± 1,600 in 1986. The 1987 estimate (19,400 ± 3,700) was considerably higher but may have included seals that had moved in from other areas as the ice began to break up (Frost et al. 1988). Frost et al. (2004) conducted surveys within 40 km of shore in the Alaskan Beaufort Sea during May-June 1996-1999, and observed ringed seal densities ranging from 0.81 seals/km^2 in 1996 to 1.17 seals/km^2 in 1999. Moulton et al. (2002) conducted similar, concurrent surveys in the Alaskan Beaufort Sea during 1997-1999 but reported substantially lower ringed seal densities than Frost et al. (2004). The reason for this disparity was unclear (Frost et al. 2004). Bengtson et al. (2005) conducted surveys in the Alaskan Chukchi Sea during May-June 1999 and 2000. While the surveys were focused on the coastal zone within 37 km of shore, additional survey lines were flown up to 185 km offshore. Population estimates were derived from observed densities corrected for availability bias using a haul-out model from ~~6~~six tagged seals. Ringed seal abundance estimates for the entire survey area were 252,488 (SE = 47,204) in 1999 and 208,857 (SE = 25,502) in 2000. The estimates from 1999 and 2000 in the Chukchi Sea only covered a portion of this stock's range and were conducted over a decade ago. Using the most recent estimates from surveys by Bengtson et al. (2005) and Frost et al. (2004) in the late 1990s and 2000, for the purposes of ~~the~~an Endangered Species Act (ESA) status review of the species, Kelly et al. (2010a) estimated the total population in the Alaskan Chukchi and Beaufort Seas ~~as~~to be at least 300,000 ringed seals, which Kelly et al. (2010a) state is likely an underestimate since the Beaufort surveys were limited to within 40 km of shore.

During April-May in 2012 and 2013, U.S. and Russian researchers conducted comprehensive and synoptic aerial abundance and distribution surveys of ice-associated seals in the Bering and Okhotsk Seas (Moreland et al. 2013). Preliminary analysis of the U.S. surveys, which included only a small subset of the 2012 data, produced an estimate of about 170,000 ringed seals in the U.S. EEZ of the Bering Sea in late April (Conn et al. 2014). This estimate does not account for availability bias, thus the actual number of ringed seals is likely much higher, perhaps by a factor of two or more. ~~These data do not include ringed seals in the Chukchi and Beaufort Seas, and so may have provided a low-biased estimate of the abundance of this DPS.~~ The full data sets are currently being processed and analyzed to provide abundance estimates for bearded, spotted, ribbon, and ringed seals in the Bering and Okhotsk Seas. Similar surveys in the Chukchi and Beaufort Seas are planned for the near future, pending funding.

Minimum Population Estimate

The estimate of 300,000 ringed seals presented in Kelly et al. (2010a) is based on estimates from surveys by Bengtson et al. (2005) and Frost et al. (2004) in the late 1990s and 2000. This ~~is not considered a reliable abundance~~ estimate~~,~~ is likely an underestimate~~, and~~ as it is based on surveys of a portion of the range, and ~~are greater~~is more than 8 years old. A reliable estimate of N_{MIN} for the total population in the Alaskan Chukchi and Beaufort Sea regions is not available.

Current Population Trend

Frost et al. (2002) reported that trend analysis based on an ANOVA comparison of observed seal densities in the central Beaufort Sea suggested marginally significant but substantial declines of 50% on shorefast ice and 31% on all ice types combined from 1985-1987 to 1996-1999. A Poisson regression model indicated highly significant density declines of 72% on shorefast ice and 43% on pack ice over the 15-year period. However, the apparent decline between the mid-1980s and the late 1990s may have been due to a difference in the timing of surveys rather than an actual decline in abundance (Frost et al. 2002, Kelly et al. 2006). As these surveys represent only a fraction of the stock's range and occurred more than a decade ago, current and reliable data on trends in population abundance for the Alaska stock of ringed seals are considered unavailable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of ringed seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for pinniped stocks with unknown population status (Wade and Angliss 1997). Since the data used to produce the abundance estimate presented in Kelly et al. (2010a) are more than 8 years old, and no reliable N_{MIN} is available, PBR is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~**New Serious Injury Guidelines**~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Between ~~2008 and 2012~~2009 and 2013, ~~there were~~ incidental serious injury~~ies~~ and mortality~~ies~~ of ringed seals was reported in 4 of the 22 federally regulated commercial fisheries in Alaska monitored for incidental mortality and serious injury by fisheries observers: the Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands pollock trawl, Bering Sea/Aleutian Islands Pacific cod trawl, and Bering Sea/Aleutian Islands Pacific cod longline fisheries (Table 1). Based on data from ~~2008 to 2012~~2009 to 2013,~~ there have been an~~ the average annual rate of mortality and serious injury ~~of 4.1 (CV = 0.06) mortalities of ringed seals~~ incidental to U.S. commercial fishing operations is 4.1 ringed seals.

Table 1. Summary of incidental mortality and serious injury of the Alaska stock of ringed seals ~~(Alaska stock)~~ due to U.S. commercial fisheries from ~~2008 to 2012~~2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). ~~Details of how~~Methods for calculating percent observer coverage ~~is measured~~ are ~~included~~described in Appendix 6 of the Alaska Stock Assessment Reports).

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Bering Sea/Aleutian Is. flatfish trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~100~~ ~~100~~99% ~~100~~99% ~~100~~99% ~~100~~99% 99%	~~2~~ 1 0 6 (+1)~~*~~[a] 3 3	~~2.0~~ 1.0 0 6.0 (~~7~~+1)~~**~~[b] 3.0 3.0	~~2.6~~2.8 (CV = ~~0.02~~N/A)
Bering Sea/Aleutian Is. pollock trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~85~~ 86% 86% 98% 98% 97%	~~1~~ 1 0 3 0 0	~~1.0~~ 1.0 0 3.0 0 0	~~1.0~~0.8 (CV = ~~0.04~~0.03)
Bering Sea/Aleutian Is. Pacific cod trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~59~~ 63% 66% 60% 68% 80%	~~0~~ 0 0 1 0 0	~~0~~ 0 0 1.0 0 0	0.2 (CV = ~~0.01~~0)
Bering Sea/Aleutian Is. Pacific cod longline	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~63~~ 60% 64% 57% 51% 67%	~~0~~ 0 0 1 0 0	~~0~~ 0 0 1.6 0 0	0.3~~2~~ (CV = 0.61)
Total estimated annual mortality						~~4.12~~4.1 (CV = ~~0.06~~0.17)

~~*~~[a]Total mortality~~ies~~ and serious injury observed in 2011: 6 in sampled hauls + 1 in an unsampled haul~~s~~.
~~**~~[b]~~Total mortalities observed in sampled and unsampled hauls.~~ Since the total known mortality and serious injury (~~7~~6 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (6.0) for the fishery in 2011, the ~~sum of actual mortalities~~ observed mortality and serious injury (~~7~~in sampled + unsampled hauls) will be used as a minimum estimate for that year.

Alaska Native Subsistence/~~Native~~ Harvest Information

~~Ringed seals are an important resource for Alaska Native subsistence hunters. The estimated annual subsistence harvest in Alaska dropped from 7,000-15,000 during 1962-1972 to an estimated 2,000-3,000 in 1979 (Frost 1985). Based on data from two villages on St. Lawrence Island, the annual take in Alaska during the mid-1980s likely exceeded 3,000 seals (Kelly 1988a).~~

~~The Alaska Department of Fish and Game (ADFG) Division of Subsistence maintained a database that provided additional information on the subsistence harvest of ice seals in different regions of Alaska (ADFG 2000a, b). Information on subsistence harvest of ringed seals was compiled for 129 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarbrough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages so their harvests were estimated using the annual per capita rates of subsistence harvest from nearby villages. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990 to 1998 were used. As of August 2000, the subsistence harvest database indicated that the estimated number of ringed seals harvested for subsistence use per year is 9,567. Data on community subsistence harvests are no longer routinely being collected, and no new statewide annual harvest estimates exist. Five Alaska Native communities in the Northwest~~

~~Arctic region of Alaska voluntarily reported a total of 40 ringed seals were harvested during 2012 (Ice Seal Committee 2013).~~

~~At this time, there are no efforts to quantify the total statewide level of harvest of ringed seals by all Alaska communities. A report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 9,567 ringed seals estimated by the Division of Subsistence is considerably higher than the previous minimum estimate reported by Frost (1985). Although some of the more recent entries in the ADFG database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not. The estimate of 9,567 ringed seals is the best estimate currently available.~~

Ringed seals are an important resource for Alaska Native subsistence hunters. Approximately 64 Alaska Native communities in western and northern Alaska, from Bristol Bay to Kaktovik, regularly harvest ice seals (Ice Seal Committee 2014). The Ice Seal Committee, as co-managers with NMFS, recognizes the importance of harvest information and has been collecting it since 2008 as funding and available personnel have allowed. Annual household survey results are compiled in a statewide harvest report that includes historical ice seal harvest information back to 1960. This report is used to determine where and how often harvest information has been collected and where efforts need to be focused in the future (Ice Seal Committee 2014). Current information, within the last five years, is available for 11 communities (Kivalina, Noatak, Buckland, Deering, Emmonak, Scammon Bay, Hooper Bay, Tununak, Quinhagak, Togiak, and Twin Hills) (Table 2), but more than 50 other communities harvest ringed seals and have not been surveyed in the last 5 years or have never been surveyed. Harvest surveys are designed to confidently estimate harvest within the surveyed community, but because of differences in seal availability, cultural hunting practices, and environmental conditions, extrapolating harvest numbers beyond that community is misleading. For example, during the past 5 years (2009-2013), only 11 of the 64 coastal communities have been surveyed for ringed seals and of those only 6 have been surveyed for two or more consecutive years (Ice Seal Committee 2015). Based on the harvest data from these 11 communities (Table 2), a minimum estimate of the average annual harvest of ringed seals in 2009-2013 is 1,040 seals per year. The Ice Seal Committee is working toward a better understanding of ice seal harvest by conducting more consecutive surveys with the goal of being able to report a statewide ice seal harvest estimate in the future.

Table 2. Ringed seal harvest estimates from 2009 to 2013 and the Alaska Native population for each community (Ice Seal Committee 2015).

Community	Alaska Native population (2013)	Estimated ringed seal harvest				
		2009	2010	2011	2012	2013
Kivalina	352			16		
Noatak	514			3		
Buckland	519			26		
Deering	176			0		
Emmonak	782			56		
Scammon Bay	498			137	169	
Hooper Bay	1144	889	458	674	651	667
Tununak	342	232	162	257	219	
Quinhagak	694		163	117	140	160
Togiak	842	1	1	0		
Twin Hills	66	0	0			
Total		1,122	784	1,286	1,179	827

Other ~~human-caused m~~Mortality~~ and injury~~

Beginning in mid-July 2011, elevated numbers of sick or dead seals, primarily ringed seals, with skin lesions were discovered in the Arctic and Bering Strait regions of Alaska. By December 2011, there were more than 100 cases of affected pinnipeds, including ringed seals, spotted seals, bearded seals, and walrus, in northern and western Alaska. Due to the unusual number of marine mammals discovered with similar symptoms across a wide geographic area, NOAA and USFWS declared a Northern Pinniped Unusual Mortality Event (UME) on December 20, 2011. Disease surveillance efforts in 2012-2013 did not detect any new cases similar to those observed in 2011, but the UME investigation remains open for ice seals based on continuing reports in 2013 and 2014 of ice seals in the Bering Strait region with patchy hair loss. To date, no specific cause for the disease has been identified (http://www.alaskafisheries.noaa.gov/protectedresources/seals/ice/diseased).

Between ~~2008 and 2012~~2009 and 2013, ~~there were 4 records of dead and injured ringed seals reported to the Alaska Regional Office Marine Mammal Stranding Network. All 3 injuries were considered not serious (Allen et al. 2014). One male ringed seal was found in 2008 with a packing band and circumferential wound around its neck; it was disentangled. Two injured ringed seals were reported in 2010, one with a bleeding flipper that was captured and released on site, another that was caught in a subsistence salmon set net. This animal was disentangled by ADFG and released. In 2011,~~ one ringed seal mortality, ~~was reported dead from~~due to a gunshot wound to the head, was reported to the NMFS Alaska Region stranding database (Helker et al. 2015). This seal, presumably a struck and lost animal from the subsistence hunt ~~(Table 2). This animal presented with~~, had skin lesions consistent with those seen in animals considered part of the multi-species ~~n~~Northern ~~p~~Pinniped~~s~~ 2011 Unusual Mortality Event.

~~**Table 2.** Summary of ringed seal (Alaska stock) mortalities and serious injures by year and type reported to the Alaska Regional Office, marine mammal stranding database, for the 2008-2012 period (Allen et al. 2014, Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.~~

~~**Cause of Injury**~~	~~**2008**~~	~~**2009**~~	~~**2010**~~	~~**2011**~~	~~**2012**~~	~~**Mean Annual Mortality**~~
~~Gunshot~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0*~~
~~Minimum total annual mortality~~						~~0.0~~

~~*Total excludes gunshot animals from Alaska since these animals are likely already accounted for in the "struck and lost" from the Alaska Native harvest estimates.~~

STATUS OF STOCK

On December 28, 2012, NMFS listed Arctic ringed seals (*Phoca hispida hispida*) and, thus, the Alaska stock of ringed seals, as threatened under the ~~Endangered Species Act~~ESA (77 FR 76706). The primary concern for this population is the ongoing and anticipated loss of sea ice and snow cover stemming from climate change, which is expected to pose a significant threat to the persistence of these seals in the foreseeable future (based on projections through the end of the 21st century; Kelly et al. 2010a). Because of its threatened status under the ESA, this stock is designated as "depleted" under the MMPA. As a result, the stock is classified as a strategic stock. Since PBR is undetermined, it is not known whether the current annual level of incidental U.S. commercial fishery-related mortality and serious injury (4.1) exceeds 10% of the PBR. However, mortality and serious injury occurring incidental to commercial fishing is likely small. The total estimated annual level of human-caused mortality and serious injury based on commercial fisheries observer data (4.1) and a minimum estimate of the Alaska Native harvest (~~9,567~~1,040) is ~~9,571~~1,044 ringed seals. Population trends and status of this stock relative to its Optimum Sustainable Population~~OSP~~ are currently unknown.

~~Habitat Concerns~~HABITAT CONCERNS

The main concern about the conservation status of ringed seals stems from the likelihood that their sea-ice and snow habitats have been modified by the warming climate and, more so, that the scientific consensus projections are for continued and perhaps accelerated warming in the foreseeable future (Kelly et al. 2010a). Climate models consistently project overall diminishing ice and snow cover through the 21st century with regional variation in the timing and severity of those loses. Increasing atmospheric concentrations of greenhouse gases are driving climate warming and increasing acidification of the ringed seal's habitat. Changes in ocean temperature, acidification, and ice cover threaten prey communities on which ringed seals depend. Laidre et al. (2008) concluded that on a worldwide basis ringed seals were likely to be highly sensitive to climate change based on an analysis of various life history features that could be affected by climate.

The greatest impacts to ringed seals from diminished ice cover will be mediated through diminished snow accumulation. While winter precipitation is forecasted to increase in a warming Arctic (Walsh et al. 2005), the duration of ice cover will be substantially reduced, and the net ~~a~~effect will be lower snow accumulation on the ice (Hezel et al. 2012). Ringed seals excavate subnivean lairs (snow caves) in drifts over their breathing holes in the ice, in which they rest, give birth, and nurse their pups for 5-9 weeks during late winter and spring (Chapskii 1940, McLaren 1958, Smith and Stirling 1975). Snow depths of at least 50-65 cm are required for functional birth lairs (Smith and Stirling 1975, Lydersen and Gjertz 1986, Kelly 1988b, Lydersen 1998, Lukin et al. 2006), and such depths typically are found only where 20-30 cm or more of snow has accumulated on flat ice and then drifted along pressure ridges or ice hummocks (Lydersen et al. 1990, Hammill and Smith 1991, Lydersen and Ryg 1991, Smith and Lydersen 1991). According to climate model projections, snow cover is forecasted to be inadequate for the formation and occupation of birth lairs within this century over the Alaska stock's entire range (Kelly et al. 2010a). Without the protection of the lairs, ringed seals—especially newborns—are vulnerable to freezing and predation (Kumlien 1879, McLaren 1958, Lukin and Potelov 1978, Smith and Hammill 1980, Lydersen and Smith 1989, Stirling and Smith 2004). Changes in the ringed seal's habitat will be rapid relative to their generation time and, thereby, will limit adaptive responses. As ringed seal populations decline, the significance of currently lower-level threats—such as ocean acidification, increases in human activities, and changes in populations of predators, prey, competitors, and parasites—may increase.

Additional habitat concerns include the potential effects from increased shipping (particularly in the Bering Strait) and oil and gas exploration activities~~,~~ (particularly in the outer continental shelf leasing areas), such as disturbance from vessel traffic, seismic exploration noise, or the potential for oil spills.

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RIBBON SEAL (*Histriophoca fasciata*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Ribbon seals inhabit the North Pacific Ocean and adjacent parts of the Arctic Ocean. In Alaska waters, ribbon seals range ~~northward~~ from ~~Bristol Bay in~~ the North Pacific Ocean and Bering Sea into the Chukchi and western Beaufort Seas (Fig. 1). From late March to early May, ribbon seals inhabit the Bering Sea ice front (Burns 1970, ~~Burns~~ 1981~~,~~; Braham et al. 1984). Ribbon seals are very rarely seen on shorefast ice or land. They are most abundant in the northern part of the ice front in the central and western parts of the Bering Sea (Burns 1970, Burns et al. 1981). As the ice recedes in May to mid-July the seals move farther to the north in the Bering Sea, where they haul out on the receding ice edge and remnant ice (Burns 1970, ~~Burns~~ 1981~~,~~; Burns et al. 1981). ~~There is little known about the range of ribbon seals during the rest of the year. Recent sightings and a review of the literature suggest that many ribbon seals migrate into the Chukchi Sea for the summer (Kelly 1988). Ribbon seal vocalizations were detected on the northern Chukchi Plateau only in late fall of 2008 and not thereafter (Moore et al. 2012). Satellite tag data from 2005 and 2007 suggest ribbon seals disperse widely.~~ As the ice melts, seals become more concentrated, with at least part of the Bering Sea population moving towards the Bering Strait and the southern part of the Chukchi Sea. By the time the Bering Sea ice recedes through the Bering Strait, there is usually only a small number of ribbon seals hauled out on the ice. Ten ribbon seals tagged in the spring of 2005 near the eastern coast of Kamchatka spent the summer and fall throughout the Bering Sea and Aleutian Islands~~; eight~~. However, of ~~the 26~~72 ribbon seals satellite tagged ~~in 2007~~ in the central Bering Sea during 2007-2010, only 21 (29%) moved to the Bering Strait, Chukchi Sea, or Arctic Basin as the ~~seasonal~~ ice retreated northward. About 9.5% of ribbon seals' time budget during July through October was in those areas. The majority of the seals tagged in the central Bering Sea did not pass north of the Bering Strait. These seals, and the 10 seals tagged in 2005 near Kamchatka, dispersed widely, occupying coastal areas as well as the interior of the Bering Sea, both on and off the continental shelf (Boveng et al. ~~2008~~2013). Year-long passive acoustic sampling on the Chukchi Plateau from autumn 2008-2009 detected ribbon seal calls only in October and November 2008 (Moore et al. 2012).

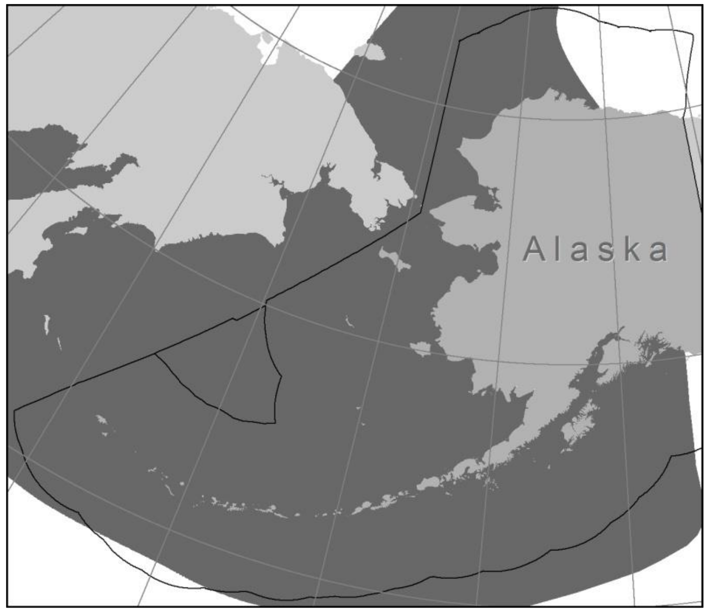

Figure 1 Approximate distribution of ribbon seals (dark shaded area) in Alaska waters. The combined summer and winter distribution is depicted.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous; 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this limited information, and the absence of any significant fishery interactions, there is currently no strong evidence to suggest splitting the distribution of ribbon seals into more than one stock (Boveng et al. ~~2008~~2013). Therefore, only the Alaska stock of ribbon seal is recognized in U.S. waters.

POPULATION SIZE

A reliable ~~abundance~~population estimate for ~~the Alaska~~the entire stock ~~of ribbon seals~~ is ~~currently~~ not available, but research programs have recently developed new survey methods and partial, but useful, abundance estimates. ~~Burns (1981) estimated the worldwide population of ribbon seals at 240,000 in the mid-1970s, with an estimate for the Bering Sea at 90,000-100,000.~~

~~Aerial surveys were conducted in portions of the eastern and central Bering Sea in spring of 2003 (Simpkins et al. 2003), 2007 (Cameron and Boveng 2007, Moreland et al. 2008), and 2008 (Cameron et al. 2008). Frequencies of sightings data from the 2007 surveys and information on ice distribution and the timings of seal haul-~~

~~out behavior were analyzed to develop a population estimate of 61,100 (95% CI 35,200–189,300) ribbon seals in the areas surveyed in that year (Ver Hoef et al. 2014).~~ In spring of 2012 and 2013, ~~NOAA~~U.S. and Russian researchers~~,~~ ~~in collaboration with Russian colleagues,~~ conducted aerial abundance and distribution surveys of the entire Bering Sea ~~(Moreland et al. 2012). Information from these surveys, and similar surveys planned for both the Bering and Okhotsk Seas in 2013, should provide the current~~and Sea of Okhotsk (Moreland et al. 2013). The data from these image-based surveys are still being analyzed, but Conn et al. (2014), using a very limited sub-sample of the data collected from the U.S. portion of the Bering Sea in 2012, calculated an abundance estimate of approximately 184,000 (95% CI: 145,752-230,134) ribbon seals in those waters. Though this should be considered only a preliminary estimate, it is appropriate to consider this a reasonable estimate for the entire U.S. population of ribbon seals because few ribbon seals are expected to be north of the Bering Strait in the spring when these surveys were conducted. When the final analyses for both the Bering and Okhotsk Seas are complete they should provide the first range-wide estimates of ribbon seal abundance.

Minimum Population Estimate

~~A reliable minimum population estimate (N_{MIN}) for this stock can not presently be determined because current reliable estimates of abundance are not available.~~The minimum population estimate (N_{MIN}) for a stock is calculated using Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the 2012 Bering Sea abundance estimate by Conn et al. (2014) provides an N_{MIN} of 163,086 ribbon seals in this stock.

Current Population Trend

At present, reliable data on trends in population abundance for the Alaska stock of ribbon seals are unavailable.~~ Although the current population trend is unknown, a recent provisional estimate of 49,000 ribbon seals in portions of the eastern and central Bering Sea is consistent enough with historical estimates to suggest that no major or catastrophic change has occurred in recent decades (Boveng et al. 2008).~~ This stock is thought to occupy its entire historically-observed range (Boveng et al. ~~2008~~2013).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for the Alaska stock of ribbon seals. Hence, until additional data become available, it is recommended that the pinniped maximum theoretical net productivity rate (R_{MAX}) of 12% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the ~~potential biological removal~~ ~~(~~PBR~~)~~ is defined as the product of the minimum population estimate (N_{MIN}), one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is ~~0.5~~1.0, the value for ~~pinniped~~ stocks ~~with unknown population status~~thought to be stable (Wade and Angliss 1997). ~~However, because a reliable estimate of minimum abundance N_{MIN} is currently not available, the PBR for this stock is unknown.~~Thus, the PBR for the Alaska stock of ribbon seals = 9,785 (163,086 × 0.06 × 1.0).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~**New Serious Injury Guidelines**~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Until 2003, there were three different federally regulated commercial fisheries in Alaska that could have interacted with ribbon seals and were monitored for incidental mortality and serious injury by fishery observers. As of 2003, changes in fishery definitions in the MMPA List of Fisheries have resulted in separating these ~~three~~3 fisheries into 13 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort~~,~~ but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between ~~2008 and 2012~~2009 and 2013, ~~there were~~ incidental mortality and serious injury~~ies and mortalities~~ of ribbon seals occurred in the Bering Sea/Aleutian Islands flatfish trawl, Bering Sea/Aleutian Islands Atka mackerel trawl, and ~~the~~ Bering Sea/Aleutian Islands pollock trawl fisheries (Table 1). The estimated ~~minimum~~average annual mortality and serious injury rate incidental to U.S. commercial fisheries is ~~1.02~~0.6 ~~(CV = 0.06)~~ ribbon seals~~ per year~~, based exclusively on ~~these~~ observer data.

Table 1. Summary of incidental mortality and serious injury of the Alaska stock of ribbon seals ~~(Alaska stock)~~ due to U.S. commercial fisheries from ~~2008 to 2012~~2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). ~~Details of how~~Methods for calculating percent observer coverage ~~is measured are included~~are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Bering Sea/Aleutian Is.~~lands~~ flatfish trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~100~~ ~~100~~99% ~~100~~99% ~~100~~99% ~~100~~99% 99%	~~0~~ 0 0 0 1 0	~~0~~ 0 0 0 1~~.0~~ 0	0.2 (CV = 0.01)
Bering Sea/Aleutian Is.~~lands~~ Atka mackerel trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~100~~ 99% ~~100~~99% ~~100~~99% ~~100~~99% 99%	~~0~~ 1 0 0 0 0	~~0~~ 1~~.00~~ 0 0 0 0	0.2 (CV = 0.01)
Bering Sea/Aleutian Is.~~lands~~ pollock trawl	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~85~~ 86% 86% 98% 98% 97%	~~2~~ 1 0 0 0 0	~~2.1~~ 1~~.0~~ 0 0 0 0	~~0.62~~0.2 (CV = ~~0.10~~0.11)
Total estimated annual mortality						~~1.02~~0.6 (CV = ~~0.06~~0.04)

Alaska Native Subsistence/~~Native~~ Harvest Information

~~Ribbon seals are harvested occasionally by Alaska Native subsistence hunters, primarily from villages in the vicinity of Bering Strait and to a lesser extent at villages along the Chukchi Sea coast (Kelly 1988). The annual subsistence harvest was estimated to be less than 100 seals annually from 1968 to 1980 (Burns 1981). In the mid-1980s, the Alaska Eskimo Walrus Commission estimated the subsistence take to still be less than 100 seals annually (Kelly 1988).~~

~~The Division of Subsistence, Alaska Department of Fish and Game maintained a database that provided additional information on the subsistence harvest of ice seals in different regions of Alaska (ADFG 2000a, b). Information on subsistence harvest of ribbon seals was compiled for 129 villages from reports from the Division of Subsistence (Coffing et al. 1998, Georgette et al. 1998, Wolfe and Hutchinson-Scarbrough 1999) and a report from the Eskimo Walrus Commission (Sherrod 1982). Data were lacking for 22 villages; their harvests were estimated using the annual per capita rates of subsistence harvest from a nearby village. Harvest levels were estimated from data gathered in the 1980s for 16 villages; otherwise, data gathered from 1990 to 1998 were used. As of August 2000, the subsistence harvest database indicated that the estimated number of ribbon seals harvested for subsistence use per year was 193. Data on community subsistence harvests are no longer routinely being collected, and no new~~

~~statewide annual harvest estimates exist. Five Alaska Native communities in the Northwest Arctic region of Alaska voluntarily reported a total of 1 ringed seal was harvested during 2012 (Ice Seal Committee 2013).~~

~~At this time, there are no efforts to quantify the total statewide level of harvest of ribbon seals by all Alaska communities. A report on ice seal subsistence harvest in three Alaskan communities indicated that the number and species of ice seals harvested in a particular village may vary considerably between years (Coffing et al. 1999). These interannual differences are likely due to differences in ice and wind conditions that change the hunters' access to different ice habitats frequented by different types of seals. Regardless of the extent to which the harvest may vary interannually, it is clear that the harvest level of 193 ribbon seals estimated by the Division of Subsistence is higher than the previous minimum estimate. Although some of the more recent entries in the ADFG database have associated measures of uncertainty (Coffing et al. 1999, Georgette et al. 1998), the overall total does not.~~

Ribbon seals are an important resource for Alaska Native subsistence hunters. Approximately 64 Alaska Native communities in western and northern Alaska, from Bristol Bay to Kaktovik, regularly harvest ice seals (Ice Seal Committee 2014). The Ice Seal Committee, as co-managers with NMFS, recognizes the importance of harvest information and has been collecting it since 2008 as funding and available personnel have allowed. Annual household survey results are compiled in a statewide harvest report that includes historical ice seal harvest information back to 1960. This report is used to determine where and how often harvest information has been collected and where efforts need to be focused in the future (Ice Seal Committee 2014). Current information, within the last 5 years, is available for 11 communities (Kivalina, Noatak, Buckland, Deering, Emmonak, Scammon Bay, Hooper Bay, Tununak, Quinhagak, Togiak, and Twin Hills) (Table 2), but more than 50 other communities harvest ribbon seals and have not been surveyed in the last 5 years or have never been surveyed. Harvest surveys are designed to confidently estimate harvest within the surveyed community, but because of differences in seal availability, cultural hunting practices, and environmental conditions, extrapolating harvest numbers beyond that community is misleading. For example, during the past 5 years (2009-2013), only 11 of the 64 coastal communities have been surveyed for ribbon seals and of those only 6 have been surveyed for two or more consecutive years (Ice Seal Committee 2015). Based on the harvest data from these 11 communities (Table 2), a minimum estimate of the average annual harvest of ribbon seals in 2009-2013 is 3.2 seals per year. The Ice Seal Committee is working toward a better understanding of ice seal harvest by conducting more consecutive surveys with the goal of being able to report a statewide ice seal harvest estimate in the future.

Table 2. Ribbon seal harvest estimates from 2009 to 2013 and the Alaska Native population for each community (Ice Seal Committee 2015).

Community	**Alaska Native population (2013)**	**Estimated ribbon seal harvest**				
		2009	**2010**	**2011**	**2012**	**2013**
Kivalina	352			0		
Noatak	514			1		
Buckland	519			0		
Deering	176			0		
Emmonak	782			0		
Scammon Bay	498			4	2	
Hooper Bay	1144	0	0	0	4	0
Tununak	342	0	0	0	0	
Quinhagak	694		2	3	0	0
Togiak	842	0	0	0		
Twin Hills	66	0	0			
Total		0	2	8	6	0

Other Mortality

Beginning in mid-July 2011, elevated numbers of sick or dead seals, primarily ringed seals, with skin lesions were discovered in the Arctic and Bering Strait regions of Alaska. By December 2011, there were more than 100 cases of affected pinnipeds, including ringed seals, spotted seals, bearded seals, and walrus, in northern and western Alaska. Due to the unusual number of marine mammals discovered with similar symptoms across a wide geographic area, NOAA and USFWS declared a Northern Pinniped Unusual Mortality Event (UME) on December 20, 2011. Disease surveillance efforts in 2012-2013 did not detect any new cases similar to those observed in 2011, but the UME investigation remains open for ice seals based on continuing reports in 2013 and 2014 of ice seals in the Bering Strait region with patchy hair loss. To date, no specific cause for the disease has been identified (http://www.alaskafisheries.noaa.gov/protectedresources/seals/ice/diseased). No ribbon seal cases were reported but they are not a coastal species and are seldom observed.

STATUS OF STOCK

Ribbon seals are not designated as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act (ESA). ~~Reliable estimates of t~~The minimum population estimate of ribbon seals in U.S. waters is 163,086, with a PBR of 9,785 ~~and human-caused mortality and serious injury are currently not available~~. Because the ~~PBR for ribbon seals is unknown, the~~estimated average annual level of ~~annual~~ U.S. commercial fishery-related mortality and serious injury (0.6) is less than 10% of PBR (979), ~~that~~it can be considered insignificant and approaching zero mortality and serious injury rate ~~is unknown~~. The total estimated annual level of human-caused mortality and serious injury based on commercial fisheries observer data (0.6) and a minimum estimate of the Alaska Native harvest (3.2) is 3.8 ribbon seals. The Alaska stock of ribbon seals is not considered a strategic stock.

~~On 20 December 2007, NMFS received a petition to list ribbon seals under the ESA, primarily due to concern about threats to the species’ habitat from climate warming and loss of sea ice. NMFS found that the petition presented sufficient information to consider listing and initiated a conservation status review of ribbon seals (73 FR 16617, 28 March 2008). After the status review of the ribbon seal was complete (Boveng et al. 2008), NMFS published a finding on December 30, 2008, that listing ribbon seals was not warranted at that time (73 FR 79822, 30 December 2008). New information became available after this finding, including data on ribbon seal movements and diving, and a modified threat-specific approach to analyzing the foreseeable future, which was used in the more recent spotted, ringed, and bearded seal ESA status reviews. In consideration of this new information, NMFS conducted a new status review of the ribbon seal (78 FR 41371; July 10, 2013) and determined that listing the ribbon seal as threatened or endangered under the ESA is not warranted at this time.~~

~~Habitat Concerns~~HABITAT CONCERNS

Evidence indicates that the Arctic climate is changing significantly and that one result of the change is a reduction in the extent of sea ice in at least some regions of the Arctic (ACIA 2004, Johannessen et al. 2004). Ribbon seals, along with other seals that are dependent on sea ice for at least part of their life history, will be vulnerable to reductions in sea ice. The main concern about the conservation status of ribbon seals stems from the likelihood that their sea-ice habitat has been modified by the warming climate and, more so, that the scientific consensus projections are for continued and perhaps accelerated warming in the foreseeable future (Boveng et al. ~~2008~~2013). A second major concern, related by the common driver of carbon dioxide (CO_2) emissions, is the modification of habitat by ocean acidification, which may alter prey populations and other important aspects of the marine ecosystem. Ocean acidification, a result of increased CO_2 in the atmosphere, may impact ribbon seal survival and recruitment through disruption of trophic regimes that are dependent on calcifying organisms. The nature and timing of such impacts are extremely uncertain. Laidre et al. (2008) concluded that on a worldwide basis ribbon seals were likely to be moderately sensitive to climate change based on an analysis of various life history features that could be affected by climate. Additional habitat concerns include the potential effects from increased shipping (particularly in the Bering Strait) and oil and gas exploration activities~~,~~ (particularly in the outer continental shelf leasing areas), such as disturbance from vessel traffic, seismic exploration noise, and the potential for oil spills.

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BELUGA WHALE (*Delphinapterus leucas*): Cook Inlet Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

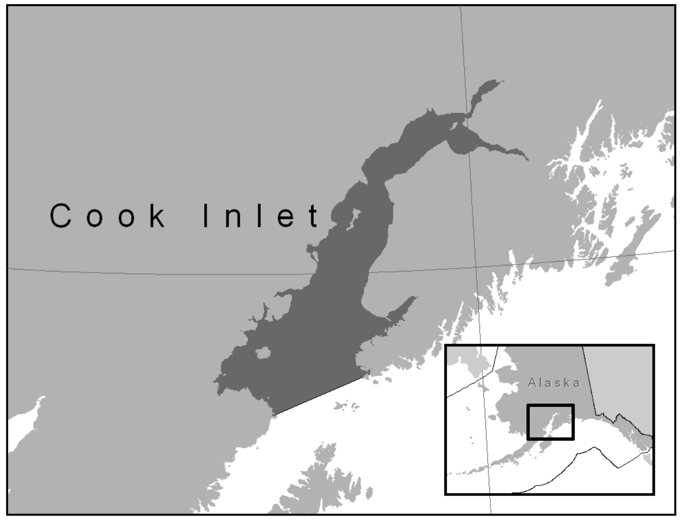

Figure 1. Approximate distribution of beluga whales in Cook Inlet.

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980)~~,~~ and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with summer concentrations in upper Cook Inlet, Bristol Bay, the eastern Bering Sea (i.e., Yukon Delta, Norton Sound), eastern Chukchi Sea (including Kotzobue Sound), and ~~the~~ Beaufort Sea (Mackenzie Delta) (Hazard 1988). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). Satellite transmitters on ~~a few~~ whales from the Beaufort Sea, Eastern Chukchi Sea, and ~~e~~Eastern Bering Sea stocks show monthly home ranges that are relatively distinct among these populations' summering areas and autumn migratory routes ~~have lasted through the winter demonstrating that beluga whales from these summering areas overwinter in the Bering Sea and the stocks may use separate wintering locations~~ (~~Suydam 2009; Alaska Beluga Whale Committee, unpubl. data~~e.g., Hauser et al. 2014). Belugas ~~found~~satellite-tagged in Bristol Bay (Quakenbush 2003, http://www.adfg.alaska.gov/index.cfm?adfg=marinemammalprogram.bristolbaybeluga) and ~~the northern Gulf of Alaska/~~ Cook Inlet (Goetz et al. 2012a) remained in those areas throughout the year ~~(Shelden 1994; Quakenbush 2003; NMFS and ADF&G, unpubl. data). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985)~~.

~~The following information was considered in classifying b~~Beluga whale stock structure was based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous (Frost and Lowry 1990); 2) Population response data: possible extirpation of local populations, distinct population trends between regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among populations in summering areas (O'Corry-Crowe et al. 2002). Based on this information, ~~5~~five beluga whale~~s~~ stocks are recognized within U.S. waters: 1) Cook Inlet (Fig. 1), 2) Bristol Bay, 3) ~~e~~Eastern Bering Sea, 4) ~~e~~Eastern Chukchi Sea, and 5) Beaufort Sea.

During ~~the open water~~ice-free months ~~in upper Cook Inlet (north of the forelands)~~, Cook Inlet beluga whales are typically concentrated near river mouths (Rugh et al. 2010~~; Fig. 1~~). The winter distribution of this stock is not well known; however, there is evidence that some whales inhabit upper Cook Inlet year-round (Hansen and Hubbard 1999, Rugh et al. 2004, Lammers et al. 2013~~Hobbs et al. 2005~~). During summers from 1999 to 2002, ~~S~~satellite tags were attached to a total of ~~17~~15 belugas ~~in late summer during 2000-2002 in order~~ to determine their distribution through the fall and winter months (Hobbs et al. 2005, Goetz et al. 2012a). Ten tags transmitted ~~through the fall~~from August to December~~,~~ and, of those, ~~three~~four tags deployed on ~~adult~~ males transmitted ~~through April~~into March and one into late May ~~(2003)~~(Goetz et al. 2012a). ~~None of the~~All tagged belugas remained in ~~moved south of Chinitna Bay on the west side of~~ Cook Inlet.

A review of all marine mammal surveys conducted in the northern Gulf of Alaska ~~from~~between 1936 ~~to~~and 2000 ~~discovered~~found only 31 beluga sightings among 23,000 marine mammal sightings, indicating that very few belugas occur~~red~~ in the Gulf of Alaska outside Cook Inlet (Laidre et al. 2000). A small number of beluga whales (fewer than 20 animals~~;~~: Laidre et al. 2000, O'Corry-Crowe et al. 2006) are regularly observed in Yakutat Bay. Although not included in the Cook Inlet distinct population segment (DPS: as listed under the Endangered Species Act (ESA)), National Marine Fisheries Service (NMFS) regulations under the Marine Mammal Protection Act

(MMPA) (50 CFR 216.15) include the beluga whales occupying Yakutat Bay as part of the depleted Cook Inlet stock (75 FR 12498, 16 March 2010)~~, defined as depleted in 50 CFR 216.15~~. Notice-and-comment rulemaking procedures would be required to change this regulatory definition. Until such procedures are completed, ~~these animals~~Yakutat Bay belugas remain designated as depleted and part of the Cook Inlet stock.

POPULATION SIZE

Aerial surveys during June documenting the early summer distribution and abundance of~~for~~ beluga whales in Cook Inlet ~~have been~~were conducted by ~~the National Marine Fisheries Service~~NMFS each year from 1993 to 2012 (Rugh et al. 2000, 2005; Shelden et al. 2013). ~~In 2013 the survey was not conducted due to cost considerations; a survey is planned for 2014 and is planned as a biennial survey in subsequent years.~~In 2013, NMFS changed to a biennial survey schedule after detailed analysis showed that there would be no reduction in assessment quality (Hobbs 2013). ~~The survey protocol includes paired, independent observers. When groups were seen, a series of aerial passes were made to allow each observer to make independent counts simultaneously with video camera recordings of the whales (Rugh et al. 2000, 2005; Shelden et al. 2013). This duel independent effort would provide two estimated counts and allow for the number of whale groups missed to be estimated.~~

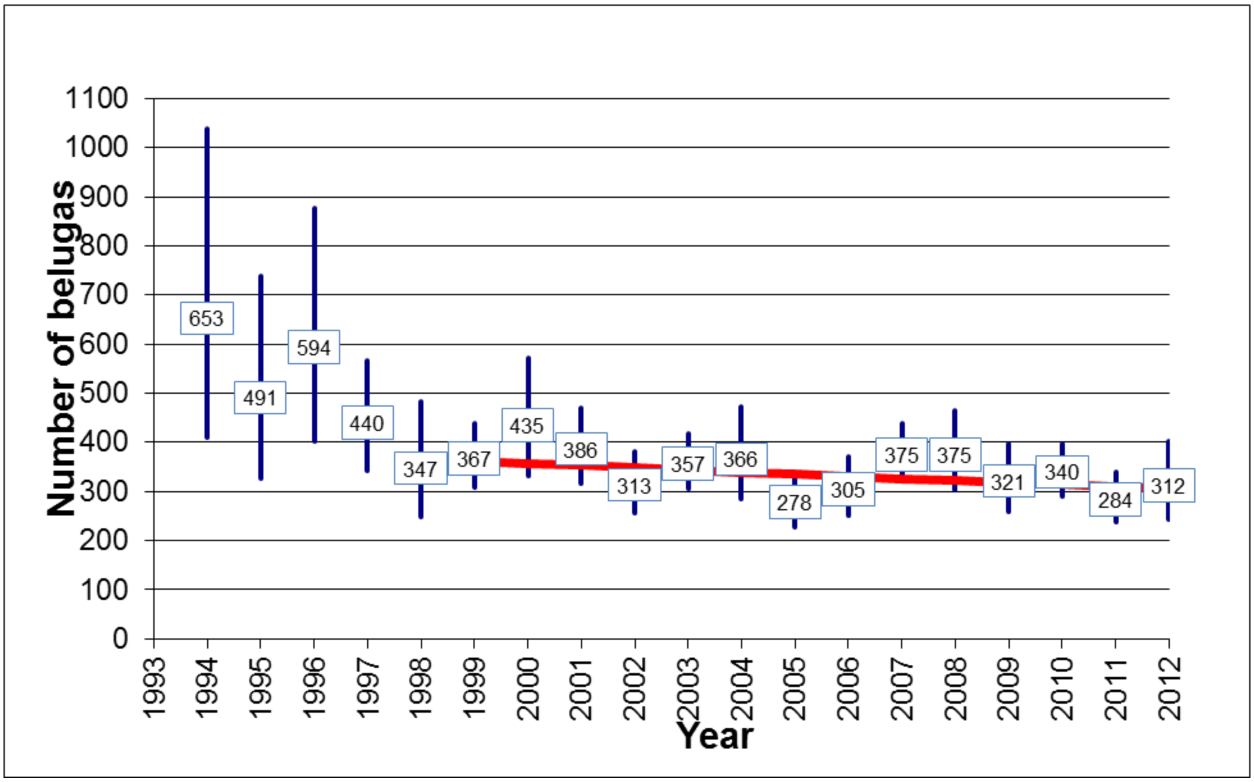

Figure 2. Annual abundance estimates of beluga whales in Cook Inlet, Alaska 1994-2012 (Hobbs et al. in press). Vertical bars depict plus and minus one standard error. ~~Over the last 10 years (2002-2012)~~From 1999 to 2012, the rate of decline (red trend line) has been ~~-0.6~~ -1.60% per year (with a 97% probability that the growth rate is declining), while the 10-year trend (2002-2012) has been -0.6% per year.

The abundance estimate for beluga whales ~~abundance~~ in Cook Inlet is ~~estimated annually~~ based on counts by aerial observers and video analysis of whale groups. Paired, independent observers count each whale group while video is collected during each counting pass. Each count ~~estimate~~ is corrected for subsurface animals (availability correction) and animals at the surface that were missed (sightability correction) based on an analysis of the video tapes (Hobbs et al. 2000). When video counts are not available, observers' counts are corrected for availability and sightability using a regression of counts and an interaction term ~~of counts~~ with an encounter rate against the video count estimates (Hobbs et al. 2000). The estimate of the abundance equation variance was revised using the squared standard error of the average for the abundance estimates in place of the abundance estimate variance and the measurement error (Hobbs at al. in press). This reduced the CVs by almost half~~, as represented in Figure 2~~. The ~~most recent annual abundance estimate was conducted in~~ June 2012 survey~~, and~~ resulted in an estimate of 312 whales (CV = 0.13) (Hobbs et al. in press). This estimate is more than the estimate of 284 belugas for 2011; however, it falls within the statistical variation around the recent trend line ~~(in red)~~ and probably represents variability of the estimation process rather than an increase in the population from 2011 to 2012. Annual abundance estimates based on aerial surveys of Cook Inlet belugas during the most recent 3-year period were 340 (2010), 284 (2011), and 312 (2012), resulting in an average abundance estimate for this stock of 312 (CV = 0.10) belugas. The most recent annual abundance estimate survey was conducted in June 2014 and is currently undergoing analyses.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) is calculated according to Equation 1 from the potential biological removal (PBR) Guidelines (Wade and Angliss 1997). Thus, $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the 3-year average population estimate (N) of 312 animals and an associated CV(N) of 0.10, N_{MIN} for the Cook Inlet ~~stock of~~ beluga whale~~s~~ stock is 280 belugas.

Current Population Trend

The corrected annual abundance estimates for the period 1994-2012 are shown in Figure 2. ~~The trend for 2002 to 2012 is an annual decline of 0.6% (SE = 0.011). The 2008 status review of the population indicated there was an 80% chance that the population would decline further (Hobbs and Shelden 2008).~~ From 1999 to 2012, the rate of decline was -1.60% (SE = 0. 75%) per year, with a 97% probability that the growth rate is declining (i.e., less than zero) (Hobbs et al. in press).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently not available for the Cook Inlet beluga whale stock. Hence, until additional data become available, the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% is recommended to be employed for this stock (Wade and Angliss 1997). This figure is similar to the 4.8% annual increase that has been documented for the Bristol Bay beluga stock (Lowry et al. 2008).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized ~~Marine Mammal Protection Act (~~MMPA~~)~~, the ~~potential biological removal (~~PBR~~)~~ ~~is~~was defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. In past Stock Assessment ~~r~~Reports from 1998 through 2005, NMFS calculated a value for PBR. ~~However, g~~Given the low abundance relative to historic estimates and low known levels of human-caused mortality since 1999, this stock should have begun to grow at or near its maximum productivity rate (2-6%), but for unknown reasons the Cook Inlet beluga whale stock is not increasing. Because this stock does not meet the assumptions inherent to the use of the PBR, NMFS has decided it would not be appropriate to calculate a maximum number that may be removed while allowing the population to achieve its ~~OSP~~Optimum Sustainable Population. Thus, the PBR for this stock is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~**New Serious Injury Guidelines**~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

~~In 1999 and 2000, observers were placed on Cook Inlet salmon set and drift gillnet vessels because of the potential for those fisheries to entangle beluga whales. No mortalities or serious injuries were observed in either~~

~~year (Manly 2006). No observer data have been collected in these fisheries since 2000. However, two entanglements have since been reported: 1) on July 14, 2005 a set net fisherman near Nikiski reported a beluga was entangled and then released from his net and the whale's condition was unknown; and 2) on May 7, 2012 a fisherman reported that a juvenile beluga was entangled in his salmon fishing net during a special use subsistence fishery near Kenai; the whale was dead, and necropsy findings reported this animal was in poor health prior to entanglement.~~

The estimated minimum average annual mortality and serious injury rate incidental to U.S. commercial fisheries is unknown, although probably low, because only one known beluga mortality ~~was~~has been reported in ~~over~~ the past 10 years.

One entanglement in a subsistence fishery was reported to the Alaska Regional Office on May 7, 2012. A fisherman reported a juvenile beluga entangled in his salmon fishing net near Kenai. The beluga was dead and necropsy findings indicated that it was in poor health prior to entanglement and the cause of death was drowning. The average annual mortality and serious injury rate due to subsistence fisheries in 2009-2013 is 0.2 belugas.

Alaska Native Subsistence/~~Native~~ Harvest Information

Subsistence harvest of beluga whales in Cook Inlet has been important to one local village (Tyonek) and the Alaska Native subsistence hunter community in Anchorage. Between 1993 and 1999, the annual subsistence take ranged from 30 to more than 100 animals, not including belugas struck but lost (Mahoney and Shelden 2000). ~~The average annual subsistence harvest, including struck and lost, for 1995 and 1996 was 87 whales (Cook Inlet Marine Mammal Council).~~

Following a significant decline in Cook Inlet beluga whale abundance estimates between 1994 and 1998, the Federal government took actions to conserve, protect, and prevent further declines in the abundance of these whales. In 1999 and 2000, Public Laws 106-31 and 106-553 established a moratorium on Cook Inlet beluga whale harvests except for subsistence hunts ~~by Alaska Natives~~ conducted under cooperative agreements between NMFS and affected Alaska Native organizations. ~~There were no signed~~These cooperative agreements, also referred to as co-management agreements, were not signed in 1999, 2004, and 2007, so no harvest was authorized. Harvests from 2001 through 2004 ~~was~~were conducted under harvest regulations (69 FR 17973, 6 April 2004) following an interim harvest management plan developed through an administrative hearing~~;~~. ~~t~~Three belugas were harvested in Cook Inlet under this interim harvest plan. In August 2004, an administrative hearing was held to ~~determine~~create a long-term harvest plan~~,~~. This plan ~~which~~ allowed ~~for~~ 8 whales to be harvested ~~during~~between 2005 and~~-~~ 2009. ~~From 2008 until recovery~~Under the plan, allowable harvest levels are established for a 5-year period, based on the average abundance in the previous 5-year period and the growth rate ~~over~~during the previous 10-year period~~;~~. ~~no~~A harvest is not allowed if the previous 5-year average abundance is less than 350 belugas. Because the 5-year average abundance during the period 2003-2007 was 336 (i.e., below 350 whales), no harvest was allowed during the subsequent 5-year period~~,~~ 2008-2012~~.~~ (73 FR 60976; 15 October 2008). ~~Since t~~The average abundance of Cook Inlet beluga whales ~~remains~~remained below 350 whales during the period ~~(~~2008-2012~~),~~; therefore, ~~no~~a harvest is not allowed for the 5-year period 2013-2017.

~~OTHER MORTALITY~~Other Mortality

Mortality~~ies~~ related to stranding events ~~have~~has been reported in Cook Inlet (Table 1). Improved record-keeping was initiated in 1994, and reports have since included the number of dead and live stranded belugas. ~~The majority of~~Most whales involved in a live stranding event probably survive, ~~recognizing that~~although some mortalities ~~are~~may be missed by observers if whales die later from strand~~ing~~-related injuries. ~~The number of whale mortalities suspected to have resulted from live strandings: 5 belugas in 1996, 5 whales in 1999, 5 belugas in 2003 (Vos and Shelden 2005); and 1 beluga in 2005 (Hobbs and Shelden 2008).~~ In 2012, there were 38 whales involved in ~~3~~three live stranding events, with no mortalities reported (Table 1). There were no live stranding events reported to NMFS in 2013. In 2014, at least 76 whales were involved in a single live stranding event in Eagle Bay in Knik Arm. That same year, necropsy results from two dead whales found near Kincaid Park along Turnagain Arm suggested the whales had recently live stranded, and that the live stranding may have contributed to their deaths, although no live stranding events were reported to NMFS (Table 1). Most live strandings ~~have~~ occur~~red~~ in Knik Arm ~~and~~or Turnagain Arm, both of which are shallow and dangerous waterways.~~, and~~ Turnagain Arm has the largest tidal range in the U.S., with a mean of 9.2 m (30 ft~~.~~).

Table 1. Cook Inlet beluga strandings investigated by NMFS during 2009-2014 (~~Vos and Shelden 2005; Hobbs and Shelden 2008,~~ NMFS, unpubl. data).* ~~Harvested beluga are not included in the number dead.~~

Year	~~Number Dead from Natural or Unknown Causes~~Beachcast carcasses	Number of ~~B~~belugas per ~~L~~live ~~S~~stranding ~~E~~event* (#number of associated known or suspected mortalities)
~~1994~~	~~108~~	~~186 (0)~~
~~1995~~	~~3~~	~~0~~
~~1996~~	~~12~~	~~63(0), 60(4), 20-30(1), 1(0), 10-20(0)~~
~~1997~~	~~3~~	~~0~~
~~1998~~	~~14~~	~~30(0), 5(0)~~
~~1999~~	~~12~~	~~58-70(5), 12-13(0)~~
~~2000~~	~~13 (3 predations)~~	~~8(0), 15-20(0), 2(0)~~
~~2001~~	~~10~~	~~0~~
~~2002~~	~~10~~	~~0~~
~~2003~~	~~20 (1 predation)~~	~~2(0), 46(5), 26(0), 32(0), 9(0)~~
~~2004~~	~~13~~	~~N/A~~
~~2005~~	~~6~~	~~7(1)~~
~~2006~~	~~8~~	~~12(0)~~
~~2007~~	~~15~~	~~0~~
~~2008~~	~~11 (1 predation?)~~	~~28(0), 30(0)~~
2009	4	~~17-20~~16-21 (0)
2010	5 ~~(1 predation)~~	11(0), 2(0)
2011	3	2(0)
2012	3	12(0), 23(0), 3(0)
2013	5	0
2014	10	76 (0), unknown (2)
Total	~~179~~30	~~735-738~~145-150 (~~16~~2)

Another source of beluga whale mortality in Cook Inlet is killer whale predation. Killer whale sightings were not well documented and appear to be rare in the upper inlet prior to the mid-1980s. ~~From 1985 to 2002 there are 18 reported sightings of killer whales in upper Cook Inlet (Shelden et al. 2003). The most recent possible predation event was reported in upper Cook Inlet in June 2010, where an adult beluga carcass, discovered near Point Possession, showed evidence of possible predation, but poor body condition of the beluga carcass prevented a positive determination.~~From 1982 through 2014, killer whale sightings in upper Cook Inlet (north of East and West Foreland) were reported to NMFS 29 times, and 9-11 beluga mortalities were suspected to be a direct result of killer whale predation. The last confirmed killer whale predation of a beluga in Cook Inlet occurred in 2008 in Turnagain Arm. In June 2010, a beluga carcass found near Point Possession was speculated to have injuries associated with killer whale predation; however, the poor condition of the beluga carcass prevented a positive determination of cause of death. From 2011 through 2014, NMFS has received no reports of killer whale sightings in upper Cook Inlet or possible predation attempts.

A photo-identification study (Kaplan et al. 2009) did not find any instances where Cook Inlet belugas appeared to have been entangled in, or to have otherwise interacted with, fishing gear. However, in 2010, a beluga with a rope entangled around its girth was observed and photo-documented during the period of May through August. The same whale was photographed in July and August 2011, ~~and~~ August 2012, and July 2013, still entangled in the rope line (~~T. McGuire, LGL Alaska Research Associates, Inc., 2000 W. International Airport Road, Anchorage, AK 99502, pers. comm., 15 February 2013~~McGuire et al. 2014). This whale is currently considered to have a non-serious injury (Helker et al. 2015).

STATUS OF STOCK

The Cook Inlet beluga whale stock was designated as "depleted" under the MMPA (65 FR 34590, May 21, 2000), and on October 22, 2008, NMFS listed Cook Inlet belugas as endangered under the ESA (73 FR 62919, October 22, 2008). Therefore, the Cook Inlet beluga whale stock is considered a strategic stock. There are no fisheries observers in Cook Inlet and there have been no voluntary reports of beluga mortalities in U.S. commercial fisheries. Annual mortality and serious injury rate for commercial fisheries is likely low, although the incompleteness of data for commercial fisheries operating within the range of Cook Inlet belugas is a concern for this small population. The total human-caused mortality and serious injury rate in 2009-2013 is 0.2 belugas per year (due to one entanglement in a subsistence fishery in 2012). NMFS convened a Recovery Team to aid in the development of a Recovery Plan for the Cook Inlet beluga whales; the Recovery Team's draft plan was submitted to NMFS in March 2013. NMFS intends to release a draft Recovery Plan for public review and comment in ~~2014~~2015, in advance of finalizing the Recovery Plan for Cook Inlet Beluga Whales (http://www.alaskafisheries.noaa.gov/protectedresources/whales/beluga/recovery/ci.htm).

~~Habitat Concerns~~HABITAT CONCERNS

Beluga whale critical habitat includes two geographic areas of marine habitat in Cook Inlet that comprise 7,800 km^2 (3,013 mi^2), excluding waters by the Port of Anchorage (76 20180, 11 April 2011).~~Based on visual observations and satellite tagging, the distribution of Cook Inlet belugas during May-September is currently restricted to the upper inlet (north of the forelands), especially the Susitna Delta, Knik Arm, Turnagain Arm, and Chickaloon Bay (Rugh et al. 2000, 2005, 2010; Goetz et al. 2007). When Cook Inlet is ice-covered, belugas expand their distribution into the waters of the upper inlet and mid-inlet (Hobbs et al. 2005).~~ Based on available information from aerial surveys, tagged whales, and opportunistic sightings, belugas remain within the inlet year-round. Since 2000, most whales have been found in the upper inlet north of East and West Foreland not only during the summer months (Rugh et al. 2010) but in the fall as well (Rugh et al. 2004), with tagged whales travelling between the lower and upper inlet and offshore waters >10 m deep during the winter (Goetz et al. 2012a). It is unknown if this contracted distribution is a result of changing habitat (Moore et al. 2000), prey concentration, or predator avoidance (Shelden et al. 2003) or can simply be explained as the contraction of a reduced population into a small number of preferred habitat areas (Goetz et al. 2007, 2012b). With the limited range of this stock, Cook Inlet belugas are vulnerable to human-induced or natural perturbations within their preferred habitat. Goetz et al. (2012b) modeled habitat preferences using NMFS' 1994-2008 abundance survey data. In large areas, such as the Susitna Delta and Knik Arm, they found a high probability of beluga presence in larger group sizes. Beluga presence also increased closer to rivers with Chinook salmon (*Oncorhynchus tshawytscha*) runs, such as the Susitna River. The Susitna Delta also supports two major spawning migrations of a small, schooling smelt (eulachon, *Thaleichthys pacificus*) in May and July.~~Although the best available information indicated that human activities, including those associated with oil and gas development, were not a contributing factor in the stock becoming in danger of extinction (65 FR 38778; 22 June 2000), potential effects from human activities impeding on beluga recovery remain a concern (73 FR 62919, 22 October 2008).~~ Additional effects that have the potential to impact this stock and its habitat include: changes in prey availability due to natural environmental variability, ocean acidification, and commercial fisheries; climatic changes affecting habitat; ~~competition with fisheries; increased~~ predation by killer whales; contaminants; noise; ship strikes~~vessel traffic~~; waste management; urban runoff; construction projects; and physical habitat modifications that may occur as Cook Inlet becomes increasingly urbanized (Moore et al. 2000, Lowry et al. 2006). ~~As part of the NMFS Recovery Plan for Cook Inlet Beluga Whales, acoustic threats are being evaluated and a list of actions will be proposed to better understand the impact of anthropogenic noise on Cook Inlet belugas, fill the gaps in knowledge and improve mitigation. A photo-identification study (McGuire et al. 2014) identified belugas that had probably been struck by boat propellers or ships.~~ Planned p~~P~~rojects ~~planned~~ that may alter the physical habitat of Cook Inlet include ~~a highway bridge across Knik Arm,~~ highway improvements;~~,~~ ~~coal~~ mine construction and operation ~~near Chuitna River~~; oil and gas exploration and development~~, as well as seismic surveys~~; and expansion and improvements to ports.~~the Port of Anchorage. Beluga whale critical habitat includes two geographic areas of marine habitat in Cook Inlet that comprise 7,800 km^2 (3,013 mi^2), excluding waters by the Port of Anchorage (76 20180, 11 April 2011).~~

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KILLER WHALE (*Orcinus orca*): AT1 Transient Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim 1978, Forney and Wade 2006). Killer whales are found throughout the North Pacific. Along the west coast of North America, seasonal and year-round occurrence of killer whales ~~occur~~has been noted along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; Forney et al. 1995). ~~Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington State, where~~ Killer whales from these areas have been labeled as “resident,” “transient,” and “offshore” type killer whales (Bigg et al. 1990, Ford et al. 2000,~~;~~ Dahlheim et al. 2008) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird et al. 1992; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000; Dahlheim et al. 2008). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Matkin et al. 1999) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood et al. 1990, Dahlheim et al. 1997). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994, Black et al. 1997, Dahlheim and White 2010).

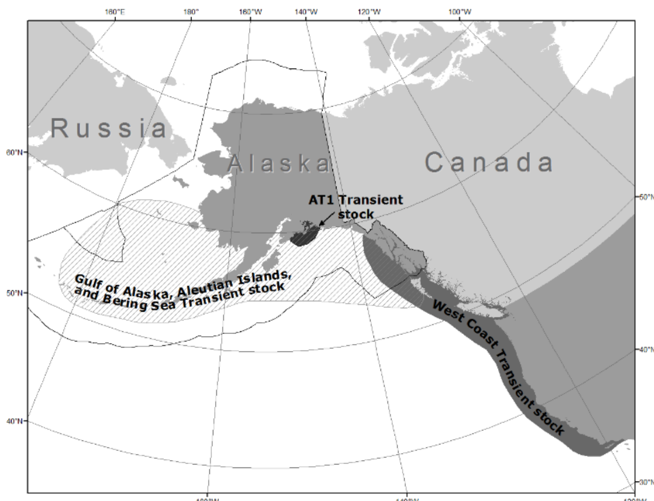

Figure 1. Approximate distribution of transient killer whales in the eastern North Pacific (shaded areas). The distribution of resident and transient killer whale stocks in the eastern North Pacific ~~Resident and Transient stocks are~~ largely overlap~~ping~~ (see text).

Several studies provide evidence that the ‘resident’, ‘offshore’, and ‘transient’ ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the ‘transient’ and ‘resident’ ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). A recent global genetic study of killer whales using the entire mitochondrial genome found that some killer whale ecotypes represent deeply divergent evolutionary lineages and warrant elevation to species or subspecies status (Morin et al. 2010). In particular, estimates from mitogenome sequence data indicate that transient killer whales diverged from all other killer whale lineages ~700,000 years ago. In light of these differences, the Society for Marine Mammalogy’s Committee on Taxonomy currently recognizes the resident and transient North Pacific ecotypes as un-named *Orcinus orca* subspecies (Committee on Taxonomy 2012). In recognition of its status as an un-named subspecies or species, some researchers now refer to transient-type killer whales as Bigg’s killer whales (e.g., Ford 2011, Riesch et al. 2012), in tribute to the late Dr. Michael Bigg.

The first studies of transient killer whales in Alaska were conducted in Southeast Alaska and in the Gulf of Alaska (from Prince William Sound, through the Kenai Fjords, and around Kodiak Island). In the Gulf of Alaska, Matkin et al. (1999) described two genetically distinct populations of transients which were never found in association with one another, the so-called “Gulf of Alaska” transients and “AT1” transients. In the past, neither of these populations were known to associate with the population of transient killer whales that ranged from California to Southeast Alaska, which are described as the ‘~~w~~West ~~c~~Coast’ ~~t~~Transient stock. ‘Gulf of Alaska’ transients are documented throughout the Gulf of Alaska, including occasional sightings in Prince William Sound. AT1 transients have been seen only in Prince William Sound and in the Kenai Fjords region, and are therefore partially sympatric with ~~‘~~Gulf of Alaska~~’~~ transients. In addition, recent data have identified 14 out of 217 transients on the outer coast of Southeast Alaska and British Columbia as Gulf of Alaska transients and in one encounter they were observed mixing with West Coast ~~T~~transients (Matkin et al. 2012, Ford et al. 2013). Transients within the ~~‘~~Gulf of Alaska~~’~~ population have been found to have two mtDNA haplotypes, neither of which is found in the ~~w~~West ~~c~~Coast or AT1 populations. Members of the AT1 population share a single mtDNA haplotype. Transient killer whales from the ~~‘w~~West ~~c~~Coast~~’~~ population have been found to share a single mtDNA haplotype that is not found in the other populations. Additionally, all three populations have been found to have significant differences in nuclear (microsatellite) DNA (Barrett-Lennard 2000). Acoustic differences have been found~~,~~ as well; Saulitis et al. (2005) described acoustic differences between ~~‘~~Gulf of Alaska~~’~~ transients and AT1 transients. For these reasons, the ~~‘~~Gulf of Alaska~~’~~ transients are considered part of a population that is discrete from the AT1 population, and both of these populations are considered discrete from the ~~‘w~~West ~~c~~Coast~~’~~ transients.

Biopsy samples from the eastern Aleutians and the south side of the west end of the Alaska Peninsula have produced the same haplotypes as killer whales in the northern Gulf of Alaska, however, nuclear DNA analysis strongly suggests they belong to a separate population (Parsons et al. 2013). The geographic distribution of mtDNA haplotypes revealed ~~S~~samples from the central Aleutian Islands and Bering Sea ~~have identified mtDNA~~with haplotypes not found in Gulf of Alaska transients, suggesting additional population structure in western Alaska. At this time, transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes ~~‘~~Gulf of Alaska~~’~~ transients. Killer whales ~~are~~ observed in the northern Bering Sea and Beaufort Sea ~~that~~ have ~~the~~ physical characteristics of transient-~~-~~type whales, but little is known about these whales. AT1 haplotype whales are also present west of the Aleutian Islands and into the Bering Sea, however, nuclear DNA analysis indicates these animals are not part of the ~~Gulf of Alaska~~ AT1 transient population in the Gulf of Alaska (L. Barrett-Lennard, Vancouver Aquarium, pers. comm., 21 March 2014).

In summary, within the transient ecotype, association data (Ford et al. 1994, Ford and Ellis 1999, Matkin et al. 1999), acoustic data (Ford and Ellis 1999, Saulitis et al. 2005~~, Ford and Ellis 1999~~) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) confirm that at least three communities of transient whales exist and represent three discrete populations: 1) Gulf of Alaska, Aleutian Islands, and Bering Sea transients, 2) AT1 transients, and 3) West Coast transients.

Based on data regarding association patterns, acoustics, movements, and genetic differences, eight killer whale stocks are now recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from Southeast Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from Washington State through part of Southeast Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from Southeast Alaska through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea, 5) the AT1 Transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast Transient stock - occurring from California through Southeast Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. ~~‘~~Transient~~’~~ whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

AT1 killer whales were first identified as a separate, cohesive group in 1984, when 22 transient-type whales were documented in Prince William Sound (Leatherwood et al. 1984, Heise et al. 1991), though individual whales from the group had been photographed as early as 1978 (von Ziegesar et al. 1986). Once the North Gulf Oceanic Society began consistent annual research effort in Prince William Sound, AT1 killer whales were re-sighted frequently. In fact, AT1 killer whales were found to be some of the most frequently sighted killer whales in Prince William Sound (Matkin et al. 1993, 1994, 1999). Gulf of Alaska transients are seen less frequently in Prince William Sound, with periods of several years or more between resightings.

AT1 killer whales have never been seen in association with sympatric resident killer whale pods or with Gulf of Alaska transients (Matkin et al. 1999, ~~Matkin et al.~~ 2012), are genetically and acoustically distinct from other transient killer whales in the North Pacific (~~Saulitis et al. 2005,~~ Barrett-Lennard 2000, Saulitis et al. 2005), and appear to have a more limited range than other transients. Their approximately 200-mile range includes only Prince William Sound and Kenai Fjords and adjacent offshore waters (Matkin et al. 1999, 2012).

POPULATION SIZE

Using photographic identification methods, all 22 individuals in the population were ~~completely~~ censused for the first time in 1984 (Leatherwood et al. 1984). All 22 AT1s were seen annually or biannually from 1984 to 1988 (Matkin et al. 1999, 2003). The *Exxon Valdez* oil spill occurred in spring of 1989. Nine individuals from the AT1 group have been missing since 1990 (last seen in 1989), and ~~2~~two have been missing since 1992 (last seen in 1990 and 1991). Three of the missing AT1s (AT5, AT7, and AT8) were seen near the leaking *Exxon Valdez* ~~(with AT6)~~ shortly after the spill (Matkin et al. 1993, 1994, 2008). Two whales were found dead, stranded in 1989-1990, both genetically assigned to the AT1 population and one visually recognized as AT19, one of the missing nine (~~Heise et al. 2003;~~ Matkin et al. 1994, 2008; Heise et al. 2003). The second unidentified whale was most likely one of the other missing AT1 whales. Additional mortalities of four older males include whales AT1 found stranded in 2000, AT13 and AT17 missing in 2002 (one of which was thought to be ~~an~~the ~~AT1~~ carcass from the AT1 population that was found in 2002), and AT14 missing in 2003. A genetically assigned AT1 stranded whale found in 2003 was probably AT14~~,~~ but could also have been AT13 (Matkin et al. 2008). No births have occurred in this population since 1984 and none of the missing whales have been seen since 2003 and are presumed dead. There is an extremely small probability (0.4%) that AT1 killer whales that are missing for 3 years or more are still alive (Matkin et al. 2008). No AT1 whale missing for at least 4 years has ever been re-sighted ~~(Matkin et al., 2008).~~ and ~~A~~all 15 missing whales are presumed dead ~~based on criteria that whales are dead if missing from the population for four or more years~~ (Matkin et al. 2008). In 2014, AT2, AT3, AT4, and AT6 were observed by researchers from the North Gulf Oceanic Society; AT9, AT10, and AT18 were not seen in 2014. Although the absence of sightings of these three whales is of some concern, they are a matriline that is typically closely associated and may not have been encountered during research cruises. Their absence may be linked to their time spent around glaciers, which are not routinely surveyed. At this time, they are not considered to be dead. Therefore, the population ~~size~~estimate as of the summer of ~~2013~~2014 remains at ~~is~~ seven whales (C. Matkin, North Gulf Oceanic Society, pers. comm., 21 March 2014). There has been no recruitment in this population since 1984 (Matkin et al. 2012).

Minimum Population Estimate

The abundance estimate of killer whales is a direct count of individually identifiable animals. Only 11 whales were seen between 1990 and 1999. Since then, ~~4~~four of those whales have not been seen for four or more consecutive years, so the minimum population estimate is ~~7~~seven whales (Matkin et al. 2008). Fourteen years of annual effort have failed to discover any whales that had not been seen previously, so there is no reason to believe there are additional whales in the population. Therefore, this minimum population estimate ~~may be~~is the total population size.

Current Population Trend

The population counts have declined from a level of 22 whales in 1989 to 7 whales in ~~2013~~2014, a decline of 68%. Most of the mortalities apparently occurred in 1989-1990.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Studies of ~~‘~~resident~~’~~ killer whale pods in the Pacific Northwest resulted in estimated population growth rates of 2.9~~2~~% and 2.5~~4~~% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). Until additional stock-specific data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, as the stock is considered depleted under the Marine Mammal Protection Act and there has been no recruitment into the stock since 1984. Thus, for the AT1 killer whale stock, PBR = 0 animals ($7 \times 0.02 \times 0.1$).

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~New Serious Injury Guidelines~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for~~

~~distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

The known range of the AT1 stock is limited to waters of Prince William Sound and Kenai Fjords. There are no federally-managed commercial fisheries in this area. State-managed commercial fisheries prosecuted within the range of this stock, such as the Prince William Sound salmon set and drift gillnet fisheries, and various herring fisheries, are not known to incur incidental serious injury~~ies~~ or mortality~~ies~~ of AT1 killer whales. Several subsistence fisheries (salmon, halibut, non-salmon finfish, and shellfish) also occur within this area, and no reports of incidental serious injury or mortality has been reported for these fisheries.

Alaska Native Subsistence/~~Native~~ Harvest Information

There are no reports of a subsistence harvest of killer whales in Alaska or Canada.

Other Mortality

Collisions with boats may be an occasional source of mortality or serious injury of killer whales. One mortality due to a ship strike occurred in 1998 when a killer whale struck the propeller of a vessel in the Bering Sea groundfish trawl fishery; however, this mortality did not involve a whale from the AT1 stock. There ~~have~~has been no known mortality~~ies~~ or serious injury of AT1 killer whales due to ship strikes. Most of the mortality occurred from 1989 to 1991 following the *Exxon Valdez* oil spill.

STATUS OF STOCK

The AT1 Transient stock of killer whales is below its Optimum Sustainable Population ~~size~~ and designated as "depleted" under the MMPA; therefore, it is classified as a strategic stock. The AT1 Transient stock ~~of killer whales~~ is not listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the estimated annual U.S. commercial fishery-related mortality and serious injury level (0) does not exceed 10% of the PBR (0) and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. At least 11 animals were alive in 1998, but it appears that ~~as of 2009,~~ only 7 individuals remain alive. The AT1 group has been reduced to 32% (7/22) of its 1984 level. Since no births have occurred in the past 30 years, it is unlikely that this stock will recover.

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PACIFIC WHITE-SIDED DOLPHIN (*Lagenorhynchus obliquidens*): North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Pacific white-sided dolphin is found throughout the temperate North Pacific Ocean, north of the coasts of Japan and Baja California, Mexico. In the eastern North Pacific the species occurs from the southern Gulf of California, north to the Gulf of Alaska, west to Amchitka in the Aleutian Islands, and is rarely encountered in the southern Bering Sea. The species is common both on the high seas and along the continental margins, and animals are known to enter the inshore passes of Alaska, British Columbia, and Washington (Ferrero and Walker 1996).

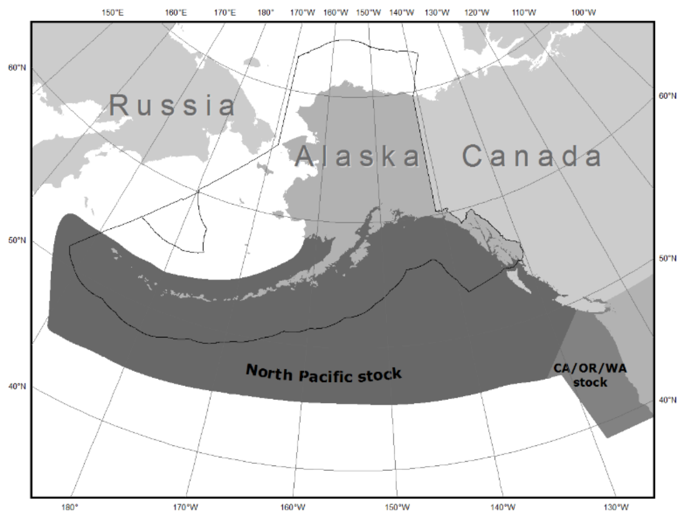

Figure 1. Approximate distribution of Pacific white-sided dolphins in the eastern North Pacific (dark shaded areas).

The following information was considered in classifying Pacific white-sided dolphin stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution is continuous; 2) Population response data: unknown; 3) Phenotypic data: two morphological forms are recognized (Walker et al. 1986, Chivers et al. 1993); and 4) Genotypic data: preliminary genetic analyses on 116 Pacific white-sided dolphin collected in four areas (Baja California, the U.S. west coast, British Columbia/~~s~~Southeast Alaska, and offshore) do not support phylogeographic partitioning, though they are sufficiently differentiated to be treated as separate management units (Lux et al. 1997). This limited information is not sufficient to define stock structure throughout the North Pacific beyond the generalization that a northern form occurs north of about 33°N from southern California along the coast to Alaska, a southern form ranges from about 36°N southward along the coasts of California and Baja California, while the core of the population ranges across the North Pacific to Japan at latitudes south of 45°N. Data are lacking to determine whether this latter group might include animals from one or both of the coastal forms. Although the genetic data are unclear, management issues support the designation of two stocks~~.~~; because the California and Oregon thresher shark/swordfish drift gillnet fishery (operating between 33°N and approximately 47°N) and, to a lesser extent, the groundfish and salmon fisheries in Alaska are known to interact with Pacific white-sided dolphins, two management stocks are recognized: 1) the California/Oregon/Washington stock, and 2) the North Pacific stock (Fig. 1). The California/Oregon/Washington stock is reported separately in the Stock Assessment Reports for the U.S. Pacific Region.

POPULATION SIZE

The most complete population abundance estimate for Pacific white-sided dolphins was calculated from line-transect analyses applied to the 1987-1990 central North Pacific marine mammal sighting~~s~~ survey data (Buckland et al. 1993). The Buckland et al. (1993) abundance estimate, 931,000 (CV = 0.90) animals, more closely reflects a range-wide estimate rather than one that can be applied to either of the two management stocks off the west coast of North America. Furthermore, Buckland et al. (1993) suggested that Pacific white-sided dolphins show strong vessel attraction but that a correction factor was not available to apply to the estimate. While the Buckland et al. (1993) abundance estimate is not considered appropriate to apply to the management stock in Alaskan waters, the portion of the estimate derived from sightings north of 45°N in the Gulf of Alaska can be used as the population estimate for this area (26,880). For comparison, Hobbs and Lerczak (1993) estimated 15,200 (95% CI: 868-265,000) Pacific white-sided dolphins in the Gulf of Alaska based on a single sighting of 20 animals. Small cetacean aerial surveys in the Gulf of Alaska during 1997 sighted one group of 164 Pacific white-sided dolphins off

Dixon entrance, while similar surveys in Bristol Bay in 1999 made 18 sightings of a school or parts thereof off Port Moller (R. Hobbs, NMFS, AFSC, NMML, pers. comm.).

Minimum Population Estimate

Historically, ~~T~~the minimum population estimate (N_{MIN}) for this stock ~~would be~~was 26,880, based on the sum of abundance estimates for ~~4~~four separate 5° × 5° blocks north of 45°N (1,970 + 6,427 + 6,101 + 12,382 = 26,880), from surveys conducted during 1987-1990, reported in Buckland et al. (1993). This ~~is~~was considered a minimum estimate because the abundance of animals in a fifth 5° × 5° block (53,885) which straddled the boundary of the two coastal management stocks ~~were~~was not included in the estimate for the North Pacific stock and because much of the potential habitat for this stock was not surveyed between 1987 ~~-~~and 1990. However, because the abundance estimate ~~used in this calculation~~ is more than 8 years old, the current minimum population estimate for this stock is unknown.

Current Population Trend

At present, there is no reliable information on trends in abundance for this stock of Pacific white-sided dolphin.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is not currently available for the North Pacific stock of Pacific white-sided dolphins. ~~Recent l~~Life history analyses by Ferrero and Walker (1996) suggest a reproductive strategy consistent with the delphinid pattern on which the 4% cetacean maximum net productivity rate (R_{MAX}) was based. Thus, it is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks of unknown status (Wade and Angliss 1997). The estimate of abundance for Pacific white-sided dolphins is ~~now~~ more than 8 years old; Wade and Angliss (1997) recommend that abundance estimates older than 8 years no longer be used to calculate a PBR level. In addition, there is no corroborating evidence from recent surveys in Alaska that provide abundance estimates for a portion of the stock's range or any indication of the current status of this stock. Thus, the PBR for this stock is undetermined (NMFS 2005).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Between 1978 and 1991, mortality and serious injury of thousands of Pacific white-sided dolphins ~~were killed~~occurred annually incidental to high-seas fisheries for salmon and squid. However, these fisheries ~~have not~~ were closed in 1991 and no other large-scale fisheries have operated in the central North Pacific since 1991.

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with Pacific white-sided dolphins. These fisheries were monitored for incidental mortality and serious injury by fishery observers. As of 2003, changes in fishery definitions in the MMPA List of Fisheries have resulted in separating these 6~~six~~ fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort~~,~~ but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. ~~There were n~~No serious injury~~ies~~ or mortality~~ies~~ of Pacific white-sided dolphins incidental to observed U.S. commercial fisheries was reported between ~~2002 and 2006~~2009 and 2013 (~~Perez 2006; Perez, unpubl. ms~~Breiwick 2013; NMML, unpubl. data).

~~The Prince William Sound salmon drift gillnet fishery was also monitored by observers in 1990 and 1991. In 1990, observers boarded 300 (57.3%) of the 524 vessels participating in that fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992). No incidental takes of Pacific white-sided dolphins were recorded in the Cook Inlet salmon driftnet and setnet fisheries (1999-2000), the Kodiak Island salmon set gillnet fishery (2002 and 2005), and Yakutat salmon setnet fishery (2007 and 2008) by the Alaska Marine Mammal Observer Program, and Pacific white-sided dolphins were not among the species spotted in the area of operations (Manly et al. 2003; Manly 2006, 2007).~~

Note that no observers have been assigned to several of the gillnet fisheries that are known to interact with this stock, making the estimated mortality and serious injury rate unreliable. However, because the stock size is large, it is unlikely that unreported mortality~~ies~~ and serious injury from those fisheries would be significant.

Alaska Native Subsistence/~~Native~~ Harvest Information

There are no reports of subsistence takes of Pacific white-sided dolphins in Alaska.

Other ~~m~~Mortality

From ~~2006-2010~~2009 to 2013, ~~there were~~ no human-caused mortality~~ies~~ or serious injury~~ies~~ of Pacific white-sided dolphins was reported to the NMFS Alaska Region ~~S~~stranding ~~Program~~database (~~NMFS Alaska Regional Office, unpublished data~~Helker et al. 2015).

STATUS OF STOCK

Pacific white-sided dolphins are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. The North Pacific stock of Pacific white-sided dolphins is not classified as a strategic stock. ~~The level of human-caused mortality and serious injury (0) is not known to exceed the PBR, which is undetermined as the most recent abundance estimate is more than 8 years old.~~ Because the PBR for Pacific white-sided dolphins is undetermined, the level of human-caused mortality and serious injury relative to PBR is unknown and the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. ~~The North Pacific stock of Pacific white-sided dolphins is not classified as a strategic stock.~~ Population trends and status of this stock relative to its ~~OSP~~Optimum Sustainable Population are currently unknown.

HABITAT CONCERNS

While the majority of Pacific white-sided dolphins are found throughout the North Pacific, there are also significant numbers found in shelf break and deeper nearshore areas. Thus, they are subject to a variety of habitat impacts. Of particular concern are nearshore areas, bays, channels, and inlets where some Pacific white-sided dolphins are vulnerable to physical modifications of nearshore habitats, resulting from urban and industrial development (including waste management and nonpoint source runoff), and noise (Linnenschmidt et al. 2013).

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HARBOR PORPOISE (*Phocoena phocoena*): Southeast Alaska Stock

NOTE – ~~March 2008~~July 2015: In areas outside of Alaska, studies of harbor porpoise distribution have ~~shown~~indicated that stock structure is likely more finely-scaled than is reflected in the Alaska Stock Assessment Reports. At this time, no data are available to define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, ~~smaller stocks are~~it is likely that several regional and sub-regional populations exist. Should new information on harbor porpoise stocks become available, the harbor porpoise Stock Assessment Reports will be updated.

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, ~~the~~ harbor porpoise range~~s~~ from Point Barrow and offshore areas of the Chukchi Sea, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984, Christman and Aerts 2015). Harbor porpoise primarily frequent the coastal waters ~~and in~~of the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2009), ~~they~~typically occurring ~~most frequently~~ in waters less than 100 m deep (Hobbs and Waite 2010). Within the inland waters of Southeast Alaska harbor porpoise distribution is clumped with greatest densities observed in the Glacier Bay/Icy Strait region and near Zarembo and Wrangell Islands and the adjacent waters of Sumner Strait (Dahlheim et al. 2009). The average density of harbor porpoise in Alaska appears to be less than that reported off the west coast of the continental U.S., although areas of high densities do occur in Glacier Bay and the adjacent waters of Icy Strait, Yakutat Bay, the Copper River Delta, ~~and~~ Sitkalidak Strait (Dahlheim et al. 2000, Hobbs and Waite 2010), and lower Cook Inlet (Shelden et al. 2014).

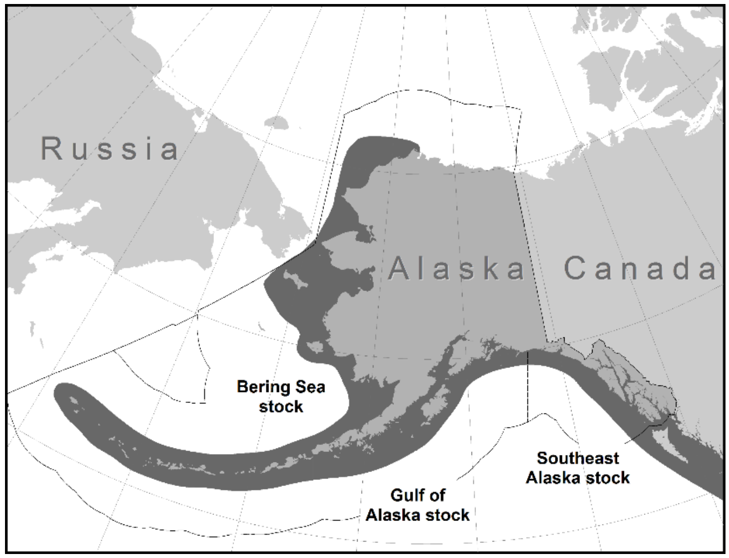

Figure 1. Approximate distribution of harbor porpoise in Alaska waters (dark shaded area).

Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the ~~W~~west ~~C~~coast (Rosel 1992), including one sample from Alaska. Two distinct mitochondrial DNA groupings or clades were found. One clade is present in California, Washington, British Columbia, and the single sample from Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991); these results are reinforced by a similar study in the northwest Atlantic (Westgate and Tolley 1999). Further genetic testing of the same samples mentioned above, along with a few additional samples including ~~8~~eight more from Alaska, found significant genetic differences for three of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). Those results demonstrate that harbor porpoise along the west coast of North America are not panmictic~~,~~ and that movement is sufficiently restricted to result in genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic (Rosel et al. 1999). Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles (Walton 1997). In a molecular genetic analysis of small-scale population structure of eastern North Pacific harbor porpoise, Chivers et al. (2002) included 30 samples from Alaska, 16 of which were from the Copper River Delta, 5 from Barrow, 5 from Southeast Alaska, and 1 sample each from St. Paul, Adak, Kodiak, and Kenai. Unfortunately, no conclusions could be drawn about the genetic structure of harbor porpoise within Alaska because of the insufficient number of samples from each region. Accordingly, harbor porpoise stock structure in Alaska is unknown at this time.

Although it is difficult to determine the true stock structure of harbor porpoise populations in the northeast Pacific, from a management standpoint~~,~~ it would be prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). For example, the porpoise concentrations found in Glacier Bay/Icy Strait and around ~~the~~ Zarembo/Wrangell Islands may represent different subpopulations (Dahlheim et al. 2015). Incidental takes from commercial fisheries within a small region (e.g., Wrangell and Zarembo Islands area) are of concern because they could impact undefined localized stocks of harbor porpoise which could go easily undetected unless stock structure is identified. The Alaska Scientific Review Group concurred that ~~while the~~ available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska~~,~~ instead of only one; however, it did not recommend against the establishment of three management units in Alaska (DeMaster 1996, 1997). Accordingly, from the above information, three harbor porpoise stocks in Alaska were recommended, recognizing that the boundaries ~~were set based on geography~~of these three stocks were identified primarily based upon geography or perceived areas of porpoise low density: 1) the Southeast Alaska stock - occurring from the northern border of British Columbia to Cape Suckling, Alaska, 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass (Fig. 1). To date, there have been no analyses to assess the validity of these stock designations.

POPULATION SIZE

Information on harbor porpoise abundance and relative abundance has been collected by the Alaska Fisheries Science Center's National Marine Mammal Laboratory (NMML) using both aerial and shipboard surveys. Aerial surveys of this stock were conducted ~~I~~in June and July ~~of~~ 1997~~, an aerial survey covering the waters of the eastern Gulf of Alaska from Dixon Entrance to Cape Suckling and offshore to the 1,000 fathom depth contour~~ and resulted in an observed abundance estimate of 3,766 (CV = 0.162) ~~animals~~porpoise (Hobbs and Waite 2010); the surveys included a subset of smaller bays and inlets. ~~The inside waters of Southeast Alaska, Yakutat Bay, and Icy Bay were included in addition to the offshore waters. The total area surveyed across inside waters, was 106,087 km^2. Only a fraction of the small bays and inlets (<5.5 km wide) of Southeast Alaska were surveyed and included in this abundance estimate, although the areas omitted represent only a small fraction of the total survey area. Two types of corrections were needed for these aerial surveys: one for observer perception bias and one to correct for porpoise availability/visibility at the surface. The observed abundance estimate includes a correction factor (1.56) for perception bias to correct for animals not counted because they were not observed. Laake et al. (1997) estimated the availability bias for aerial surveys of harbor porpoise in Puget Sound to be 2.96 (CV = 0.180); the use of this correction factor is preferred to other published correction factors (e.g., Barlow et al. 1988, Calambokidis et al. 1993) because it is an empirical estimate of availability bias.~~ Correction factors for observer perception bias and porpoise availability at the surface were used to develop an~~The~~ estimated corrected abundance ~~from this survey is~~of 11,146 (3,766 × 2.96; CV = 0.242) harbor porpoise ~~for both~~in the coastal and inside waters of Southeast Alaska (Hobbs and Waite 2010).

In 1991, researchers ~~from the AFSC National Marine Mammal Laboratory (NMML)~~ initiated harbor porpoise studies aboard the NOAA ship *John N. Cobb* with survey coverage throughout the inland waters of Southeast Alaska. Between 1991 and 1993, line-transect methodology was used to~~:~~ 1) obtain population estimates of harbor porpoise, 2) establish a baseline for detecting trends in abundance, and 3) define overall distributional patterns and seasonality of harbor porpoise. ~~Three s~~Surveys were carried out each year ~~spanning~~in the spring, summer, and fall. Annual surveys were continued between 1994 and 2005; however, only two trips per year were conducted, one either in spring or summer and the other in fall. Although standard line-transect methodology was not used, all cetaceans observed were recorded. During this 12-year period, observers reported fewer overall encounters with harbor porpoise. To fully assess abundance and population trends for harbor porpoise, line-transect methodology was used during the survey cruises in 2006 and 2007 (Dahlheim et al. 2009) and ~~again~~ in 2010-2012~~, 2011, and 2012~~. Previous studies reported no evidence of seasonality for harbor porpoise occupying the inland waters of Southeast Alaska. Thus, we opted to analyze data collected during the summer season only, given the broader spatial coverage and the greater number of surveys completed for this season (i.e., representing a total of ~~8~~eight line-transect vessel surveys). Methods applied to the 2006-2012 surveys were comparable to those employed during the early 1990s; however, because these surveys only covered inland waters and not the entire range of this stock, ~~and therefore are not used to calculate overall~~they are not used to compute a stock-specific estimate of abundance. ~~Within e~~Each year, greater densities of harbor porpoise were observed in the Glacier Bay/Icy Strait region and near Zarembo and Wrangell Islands and adjacent waters of Sumner Strait. ~~Abundance for harbor~~

~~porpoise occupying the inland waters of Southeast Alaska fluctuated by year with total abundance highest in 1991 (N = 1,485, CV = 0.16), lowest in 2006 (N = 527, CV = 0.20), and 2012 values at N = 1,081, CV = 0.15).~~ Abundance estimates for inland waters of Southeast Alaska were found to vary across survey periods spanning the 22-year study (1991-2012). Abundance (N = 1,076, 95% CI = 910-1,272) in 1991-1993 was higher than the estimate obtained for 2006-2007 (N = 604, 95% CI = 468-780) but comparable to the estimate for 2010-2012 (N = 975, 95% CI = 857-1,109; Dahlheim et al. 2015). These estimates ~~overall abundance estimation~~ assume~~s~~ g(0) = 1 (the probability of detection directly on the track line) and, therefore, may be ~~substantially~~ biased low to an unknown degree. A range of possible g(0) values for harbor porpoise vessel surveys in other regions is 0.5-0.8 (Barlow et al. 1988, Palka 1995).

Minimum Population Estimate

For the Southeast Alaska stock of harbor porpoise, the minimum population estimate (N_{MIN}) for the 1997 aerial surveys is 1,996 calculated using Equation 1 from the potential biological removal (PBR) ~~G~~guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{1/2})$. ~~Using the population estimate (N) of 11,146 from 1997 and its associated CV (0.242),~~ ~~N_{MIN}~~ ~~for this stock is 9,116 (Hobbs and Waite 2010).~~ However, because the survey data are now more than 8 years old, ~~it is not considered a reliable minimum population estimate for calculating a~~the N_{MIN} is considered unknown and PBR cannot be determined. The 2010-2012 abundance estimate for harbor porpoise occupying the inland waters of Southeast Alaska of ~~1,081~~975 (~~CV=0.15~~95% CI = 857-1,109) ~~only~~ represents a small ~~area within the entire~~portion of the total number of animals in the stock~~ boundaries~~. Therefore, this number would not be an accurate estimate of N_{MIN} for the entire stock of Southeast Alaska harbor porpoise. However, since a PBR calculation for the Wrangell and Zarembo Islands area of the inland waters of Southeast Alaska is useful to provide context for the harbor porpoise takes in the Southeast Alaska salmon drift gillnet fishery in this area, which was monitored in 2012-2013, we used the pooled 2010-2012 abundance estimate of 526 (CV = 0.15) for the Wrangell and Zarembo Islands area (Dahlheim et al. 2015) to calculate an N_{MIN} of 463 for this area of the inland waters of Southeast Alaska. The porpoise survey area for which the abundance estimate and N_{MIN} were calculated (Area 5: Dahlheim et al. 2015) partially overlaps ADF&G Districts 6 and 8, which are two of the three districts (6, 7, and 8) where the fishery was observed (Manly 2015).

Current Population Trend

The abundance of harbor porpoise for the Southeast Alaska stock was estimated in 1993 and 1997. In 1993, abundance estimates were determined from a coastal aerial survey from Prince William Sound to Dixon Entrance and a vessel survey in the inside waters of Southeast Alaska (Dahlheim et al. 2000). These surveys produced abundance estimates of 3,982 and 1,586 for the two areas, respectively, giving a combined estimate for the range of the Southeast Alaska harbor porpoise stock of 5,568. The 1997 abundance estimate was determined with an aerial survey for both the coastal region from Prince William Sound to Dixon Entrance and the inside waters of Southeast Alaska (Hobbs and Waite 2010). The 1997 estimate of 11,146 is double the 1993 estimate; however these estimates are not directly comparable because of differences in survey methods. The total area for the 1997 survey was greater than in 1993 and included a correction of perception bias.

An analysis of the line-transect vessel survey data collected throughout the inland waters of Southeast Alaska between 1991 and 2010 suggested high probabilities of a population decline ranging from 2 to 4% per year for the whole study area (Zerbini et al. 2011), thus highlighting a potentially important conservation issue. However, when data from 2011 and 2012 were added to this analysis, the ~~rate of~~ population decline~~ decreased substantially and~~ was no longer significant (Dahlheim et al. 2015). It is still unclear why the population estimate fluctuation ~~observed~~ for harbor porpoise in Southeast Alaska occurred. ~~It is possible that the negative trends seen between 1991 and 2010 occurred as a result of a combination of factors including increased mortality due to bycatch or predation or shifts in distribution due to changes in prey abundance. Interestingly, w~~When examined on a more regional scale, abundance was relatively constant in Glacier Bay throughout the survey period. In contrast, ~~large~~ declines were documented for the Wrangell and Zarembo Islands area~~s~~; an area where net fisheries occur.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate (R_{MAX}) is not currently available for the Southeast Alaska stock of harbor porpoise. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate of 4% be employed (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the ~~potential biological removal (~~PBR~~)~~ is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). ~~However, t~~The SAR guidelines (Wade and Angliss 1997) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate. Therefore, the PBR for this stock is considered undetermined (NMFS 2005). A PBR calculation for the Wrangell and Zarembo Islands area of the inland waters of Southeast Alaska is useful to provide context for the observed takes of harbor porpoise in this area of the Southeast Alaska salmon drift gillnet fishery in 2012-2013. This PBR calculation, based on the pooled 2010-2012 abundance estimate of 526 (CV = 0.15) and its corresponding N_{MIN} of 463, for the Wrangell and Zarembo Islands area of the inland waters of Southeast Alaska, is 4.6.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~**New Serious Injury Guidelines**~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Until 2003, there were three different federally-regulated commercial fisheries in Alaska that could have interacted with the Southeast Alaska stock of harbor porpoise. As of 2003, changes in fishery definitions in the MMPA List of Fisheries resulted in separating the Gulf of Alaska (GOA) groundfish fisheries into many fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort~~,~~ but provides managers with better information on the component of each fishery responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. These fisheries (GOA Pacific cod longline, Pacific halibut longline, rockfish longline, and sablefish longline) were monitored for incidental mortality by fishery observers from ~~2007 to 2011~~2009 to 2013, although observer coverage has been very low in the offshore waters of Southeast Alaska (Appendix 6; Breiwick 2013; NMML, unpubl. data). No mortality~~ies~~ or serious injury has been observed from this stock of harbor porpoise incidental to commercial groundfish fisheries~~ have been observed~~. There is no consistent observer coverage for fisheries operating within the inside waters of Southeast Alaska. A reliable estimate of the mortality and serious rate incidental to commercial fisheries is currently unavailable because of the ~~near-absence of~~limited observer placements in Southeast Alaska fisheries. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate is insignificant.

In 2007 and 2008, the Alaska Marine Mammal Observer Program (AMMOP) placed observers in four regions where the state-managed Yakutat salmon set gillnet fishery operates (Manly 2009). These regions included the Alsek River area, the Situk area, the Yakutat Bay area, and the Kaliakh River and Tsiu River areas. ~~Overall observer coverage was 5.3% in 2007 and 7.6% in 2008.~~ Based on observed mortality~~ies~~ and serious injury during these 2~~two~~ years, the estimated mean annual mortality and serious injury rate ~~of harbor porpoise~~ in the Yakutat salmon set gillnet fishery was ~~21.8~~22 harbor porpoise (Table 1).

~~In 2011, an observer pilot study began within the inland waters of Southeast Alaska. This effort was based out of Wrangell and Petersburg, Alaska.~~ In 2012 and 2013, the AMMOP placed observers on independent vessels in the state-managed Southeast Alaska salmon drift gillnet fishery to assess ~~harbor porpoise~~ mortality and serious injury of marine mammals~~associated with gillnet fisheries~~. Areas around and adjacent to Wrangell and Zarembo Islands (ADF&G Districts 6, 7, and 8) were ~~targeted~~observed during the 2012-2013 program (Manly 2015)~~, however, overall coverage was low~~. ~~In 2012, there were no incidental takes of harbor porpoise reported through this observer program.~~ In 2013, ~~two~~four harbor porpoise were ~~captured alive~~entangled and released~~ apparently uninjured~~: two were determined to be seriously injured and two were determined to be not seriously injured. Based on the two observed serious injuries, 23 serious injuries were estimated for Districts 6, 7, and 8 in 2013, resulting in an estimated mean annual mortality and serious injury rate of 12 harbor porpoise per year in 2012-2013 (Table 1). Since these three districts represent only a portion of the overall fishing effort in this fishery, we expect this to be a minimum estimate of mortality for the fishery.

Table 1. Summary of incidental mortality and serious injury of harbor porpoise from the Southeast Alaska stock due to U.S. commercial fisheries in ~~2007 and 2008~~2009-2013 and calculation of the mean annual mortality and serious injury rate (Manly 2009, 2015). ~~Details of how~~Methods for calculating percent observer coverage ~~is measured~~ are ~~included~~described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	**Years**	**Data type**	**Percent ~~O~~observer coverage**	**Observed mortality ~~(in given yrs.)~~**	**Estimated mortality ~~(in given yrs.)~~**	**Mean estimated annual mortality**
Yakutat salmon set gillnet	2007 2008	obs data	5.3% 7.6%	1 3	16.1 27.5	~~21.8~~22 (CV = 0.54)
SE Alaska salmon drift gillnet (Districts 6, 7, and 8)	2012 2013	obs data	6.4% 6.6%	0 2	0 23	12 (CV = 1.0)
Minimum total estimated annual mortality						~~21.8 (CV = 0.54)~~ 34 (CV = 0.77)

~~There were 3 mortalities of harbor porpoise due to entanglement in fishing gear near Yakutat reported to the NMFS stranding network between 2008 and 2012 (Table 2). Two mortalities occurred in 2009, one in a set gillnet and one in a subsistence king salmon gillnet. A single porpoise entangled in an unspecified gillnet fishery was reported to the stranding network in 2010; this animal died after a disentanglement attempt by the fisher.~~ Two harbor porpoise mortalities, due to entanglement in Yakutat salmon set gillnets, were reported to the NMFS Alaska Region, one each in 2009 and 2010; however, the AMMOP mean estimated annual mortality for the fishery accounts for these mortalities (Table 1).

A harbor porpoise mortality, due to entanglement in a subsistence king salmon set gillnet, was reported to the NMFS Alaska Region in 2009, resulting in an~~The~~ estimated minimum mean annual mortality and serious injury rate of 0.2 harbor porpoise in ~~Southeast Alaska based on incidental catch reported to the stranding network is 0.6 for the 5-year period~~this fishery from ~~2008 to 2012~~2009 to 2013 (Table 2).

Table 2. Summary of incidental mortality and serious injury of the Southeast Alaska stock of harbor porpoise ~~mortalities and serious injuries~~, by year and type, reported to the NMFS Alaska Regional ~~Office~~, marine mammal stranding database, ~~for the 2008-2012 period~~in 2009-2013 (~~Allen et al. 2014,~~ Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of ~~I~~injury	**~~2008~~**	**2009**	**2010**	**2011**	**2012**	**2013**	**Mean ~~A~~annual ~~M~~mortality**
~~Caught in Yakutat salmon set gillnet~~	~~0~~	~~1~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0.4~~
Caught in Yakutat subsistence king salmon set gillnet	~~0~~	1	0	0	0	0	0.2
~~Stabbed~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0.2~~
~~Minimum total annual mortality~~							~~0.80~~

Alaska Native Subsistence/~~Native~~ Harvest Information

Subsistence hunters in Alaska have not been reported to take from this stock of harbor porpoise.

~~Other Mortality~~

~~Stranding data may also provide information on additional sources of potential human-related mortality. In 2008, there was one report to NOAA's Office of Law Enforcement of a harbor porpoise that had been found floating dead with multiple stab wounds and chaffing on fins suggesting possible net entanglement (Table 2). This event is~~

~~likely a result of fishery interaction; however, since the cause of death was not confirmed to be due to incidental catch in commercial fisheries, this human-caused mortality is being summarized within the "other mortality" section. The average minimum annual human-caused mortality and serious injury of Southeast Alaska harbor porpoise based on unconfirmed incidental catch and other human-caused activity reported to the stranding network is 0.2 for the 5-year period from 2008 to 2012.~~

STATUS OF STOCK

Harbor porpoise are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Because the PBR is ~~unknown~~undetermined, the ~~level of~~ annual level of U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. The total estimated annual level of human-caused mortality and serious injury based on observer data (~~21.8~~34) and stranding data (~~0.8~~0.2) is ~~22.6~~34 harbor porpoise from this stock. Because the abundance estimates are more than 8 years old (with the exception of the 2010-2012 abundance estimates provided for the inland waters of Southeast Alaska and for the Wrangell and Zarembo Islands area) and the frequency of incidental mortality and serious injury in U.S. commercial fisheries throughout Southeast Alaska is not known, the Southeast Alaska stock of harbor porpoise is classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population~~OSP~~ are currently unknown.

HABITAT CONCERNS

~~Most h~~Harbor porpoise are mostly found in waters less than 100 m ~~in depth~~deep and they often concentrate in near-shore areas and inland waters, including bays, tidal areas, and river mouths (Dahlheim et al. 2000, 2009; Hobbs and Waite 2010). As a result, harbor porpoise are ~~more~~ vulnerable to ~~nearshore~~ physical ~~habitat~~ modifications of nearshore habitats resulting from urban and industrial development~~,~~ (including waste management~~,~~ and nonpoint source runoff)~~,~~ and ~~physical habitat modifications including~~ activities such as construction of docks and other over-water structures, filling of shallow areas, ~~and~~ dredging, and noise (Linnenschmidt et al. 2013).

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Revised ~~10/09/2014~~9/8/2015

HARBOR PORPOISE (*Phocoena phocoena*): Gulf of Alaska Stock

NOTE – ~~March 2008~~July 2015: In areas outside of Alaska, studies of harbor porpoise distribution have ~~shown~~indicated that stock structure is likely more finely-scaled than is reflected in the Alaska Stock Assessment Reports. At this time, no data are available to define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, ~~smaller stocks are~~it is likely that several regional and sub-regional populations exist. Should new information on harbor porpoise stocks become available, the harbor porpoise Stock Assessment Reports will be updated.

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow and offshore areas of the Chukchi Sea, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984, Christman and Aerts 2015). Harbor porpoise primarily frequent the coastal waters ~~and in~~of the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2009), ~~they~~typically occurring ~~most frequently~~ in waters less than 100 m deep (Hobbs and Waite 2010). The average density of harbor porpoise in Alaska appears to be less than that reported off the west coast of the continental U.S., although areas of high densities do occur in Glacier Bay and the adjacent waters of Icy Strait, Yakutat Bay, the Copper River Delta, ~~and~~ Sitkalidak Strait (Dahlheim et al. 2000, Hobbs and Waite 2010), and lower Cook Inlet (Shelden et al. 2014).

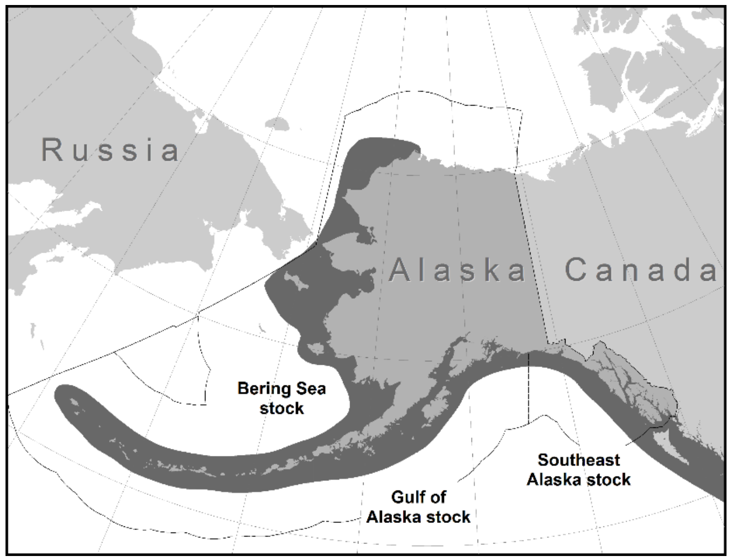

Figure 1. Approximate distribution of harbor porpoise in Alaska waters (dark shaded area).

Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the ~~W~~west ~~C~~coast (Rosel 1992), including one sample from Alaska. Two distinct mitochondrial DNA groupings or clades were found. One clade is present in California, Washington, British Columbia, and the single sample from Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991); these results are reinforced by a similar study in the northwest Atlantic (Westgate and Tolley 1999). Further genetic testing of the same samples mentioned above, along with a few additional samples including ~~8~~eight more from Alaska, found significant genetic differences for three of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). Those results demonstrate that harbor porpoise along the west coast of North America are not panmictic~~,~~ and that movement is sufficiently restricted to result in genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic (Rosel et al. 1999). Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles (Walton 1997). In a molecular genetic analysis of small-scale population structure of eastern North Pacific harbor porpoise, Chivers et al. (2002) included 30 samples from Alaska, 16 of which were from Copper River Delta, 5 from Barrow, 5 from Southeast Alaska, and 1 sample each from St. Paul, Adak, Kodiak, and Kenai. Unfortunately, no conclusions could be drawn about the genetic structure of harbor porpoise within Alaska because of the insufficient number of samples from each region. Accordingly, harbor porpoise stock structure in Alaska is unknown at this time.

Although it is difficult to determine the true stock structure of harbor porpoise populations in the northeast Pacific, from a management standpoint, it would be prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). The Alaska Scientific Review Group concurred that ~~while the~~ available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska instead of only one; however, it did not recommend against the establishment of three management units in Alaska (DeMaster 1996, 1997). Accordingly, from the above information, three harbor porpoise stocks in Alaska ~~are~~were ~~recommended~~identified, recognizing that the boundaries of these three stocks were inferred primarily based upon geography or perceived areas of low porpoise density~~were set based on geography~~: 1) the Southeast Alaska stock - occurring from the northern border of British Columbia to Cape Suckling, Alaska, 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass (Fig. 1). To date, there have been no analyses to assess the validity of these stock designations.

POPULATION SIZE

In June and July of 1998, an aerial survey covered the waters of the western Gulf of Alaska from Cape Suckling to Sutwik Island, offshore to the 1,000 fathom depth contour. Two types of corrections were needed for these aerial surveys: one for observer perception bias and one to correct for porpoise availability/visibility at the surface. The 1998 survey resulted in an abundance estimate for the Gulf of Alaska harbor porpoise stock of 10,489 (CV = 0.115) animals (Hobbs and Waite 2010), which includes a correction factor (1.372; CV = 0.066) for perception bias to correct for animals that were present but not counted because they were not detected by observers. Laake et al. (1997) estimated the availability bias for aerial surveys of harbor porpoise in Puget Sound to be 2.96 (CV = 0.180); the use of this correction factor is preferred to other published correction factors (e.g., Barlow et al. 1988, Calambokidis et al. 1993) because it is an empirical estimate of availability bias. The estimated corrected abundance estimate from the 1998 survey is 31,046 (10,489 × 2.96 = 31,046; CV = 0.214) (Hobbs and Waite 2010).

This latest estimate of abundance (31,046) is considerably higher than the estimate reported in the 1999 stock assessment (8,271; CV = 0.309), which was based on surveys in 1991-1993. This disparity largely stems from changes in the area covered by the two surveys and differences in harbor porpoise density encountered in areas added to, or dropped from, the 1998 survey, relative to the 1991-1993 surveys. The survey area in 1998 (119,183 km^2) was greater than the area covered in the combined portions of the 1991, 1992, and 1993 surveys (106,600 km^2). The 1998 survey included selected bays, channels, and inlets in Prince William Sound, the outer Kenai Peninsula, the south side of the Alaska Peninsula, and the Kodiak Archipelago, whereas, the earlier survey included only open water areas. Several of the bays and inlets covered by the 1998 survey had higher harbor porpoise densities than observed in the open waters. In addition, the 1998 estimate provided by Hobbs and Waite (2010) empirically estimates the perception bias~~,~~ and uses this in addition to the correction factor for availability bias. Finally, the 1998 estimate extrapolates available densities to estimate the number of porpoise which would likely be found in unsurveyed inlets within the study area. For these reasons, the 1998 survey result is probably more representative of the size of the Gulf of Alaska harbor porpoise stock.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the potential biological removal (PBR) ~~G~~guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of 31,046 and its associated CV of 0.214, N_{MIN} for the Gulf of Alaska stock of harbor porpoise is 25,987 (Hobbs and Waite 2010). However, because the survey data are now more than 8 years old, ~~it is not considered a reliable minimum population estimate for calculating a PBR~~N_{MIN} is considered unknown.

Current Population Trend

At present, there is no reliable information on trends in abundance for the Gulf of Alaska stock of harbor porpoise since survey methods and results are not comparable.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate (R_{MAX}) is not currently available for the Gulf of Alaska stock of harbor porpoise. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate of 4% be employed (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the ~~potential biological removal (~~PBR~~)~~ is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). However, the 2005 revisions to the SAR guidelines (Wade and Angliss 1997) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate. Therefore, the PBR for this stock is considered undetermined (NMFS 2005).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~New Serious Injury Guidelines~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Prior to 2003, three different federally-managed commercial fisheries operating within the range of the Gulf of Alaska stock of harbor porpoise were monitored by NMFS observers for incidental take: the Gulf of Alaska groundfish trawl, longline, and pot fisheries. As of 2003, changes in fishery definitions in the MMPA List of Fisheries resulted in separating these 3 Gulf of Alaska (GOA) fisheries into 10 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort~~,~~ but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. No incidental mortality or serious injury of harbor porpoise was observed in these fisheries. Observers also monitored the State of Alaska-managed Prince William Sound salmon drift gillnet fishery in 1990 and 1991, recording ~~one~~1 mortality in 1990 and 3~~three mortalities~~ in 1991~~. These mortalities~~, which extrapolated to 8 (95% CI: 1-23) and 32 (95% CI: 3-103) ~~kills~~ for the entire fishery, resulting in a mean annual ~~kill~~mortality and serious injury rate of 20 (CV = 0.60) animals per year for 1990 and 1991 (Wynne et al. 1991, 1992) (Table 1). ~~In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992).~~ The Prince William Sound salmon drift gillnet fishery has not been observed since 1991~~; therefore,~~ and no additional data are available for that fishery.

In 1999 and 2000, observers were placed on the state-managed Cook Inlet salmon set and drift gillnet vessels ~~primarily because of the potential for these fisheries to cause incidental mortalities of beluga whales~~. One harbor porpoise mortality was observed in 2000 in the Cook Inlet salmon drift gillnet fishery (Manly 2006). This single mortality extrapolates to an estimated mortality and serious injury rate~~level~~ of 31~~.2~~ for that year~~,~~ and an average of ~~15.6~~16 per year when averaged over the 2 years of observer data (Table 1).

In 2002 and 2005, observers were placed on state-managed Kodiak Island set gillnet vessels. Two harbor porpoise mortalities were observed in this fishery in both 2002 and 2005 ~~in this fishery~~ (Manly 2007)~~. These mortalities~~ which extrapolates to an estimated mean annual mortality and serious injury rate~~level~~ of ~~35.8~~36 ~~animals~~harbor porpoise per year (~~Manly 2007~~Table 1).

Table 1. Summary of incidental mortality and serious injury of the Gulf of Alaska stock of harbor porpoise ~~(Gulf of Alaska stock)~~ due to state-managed fisheries from 1990 through 2005~~,~~ and calculation of the mean annual mortality and serious injury rate (Wynne et al. 1991, 1992; Manly 2006, 2007). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	~~Range of~~ Percent observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Prince William Sound salmon drift gillnet	1990 1991	obs data	4% 5%	1 3	8 32	20 (CV = 0.60)

Fishery name	**Years**	**Data type**	**~~Range of~~ Percent observer coverage**	**Observed mortality ~~(in given yrs.)~~**	**Estimated mortality ~~(in given yrs.)~~**	**Mean estimated annual mortality**
Cook Inlet salmon drift gillnet	1999 2000	obs data	1.6%~~[1]~~ 3.6%~~[1]~~	0 1	0 31~~.2~~	~~15.6~~16 (CV = 1.0)
Cook Inlet salmon set gillnet	1999 2000	obs data	0.16-1.1%~~[1]~~ 2.7%~~[1]~~	0 0	0 0	0
Kodiak Island set gillnet	2002 2005	obs data	6.0% 4.9%	2 2	32~~.2~~ 39~~.4~~	~~35.8~~36 (CV = 0.68)
Minimum total estimated annual mortality						~~71.4~~72 (CV = 0.44)

~~[1]Manley 2006.~~

Strandings of marine mammals with fishing gear attached or with injuries caused by interactions with fishing gear are another source of mortality data.~~Between 2008 and 2012, the NMFS stranding network received one report of a Gulf of Alaska harbor porpoise entanglement in Cook Inlet, a self-report by a fisher of a mortality that occurred in a commercial silver salmon fishing net off Kalgin Island in 2008 (Table 2). An estimate of annual mortality and serious injury occurring in the commercial Cook Inlet gillnet fisheries has been derived from observer data; therefore, this single event is considered to be accounted for in the extrapolated estimate of mortality for these fisheries.~~ Between 2009 and 2013, one Gulf of Alaska harbor porpoise mortality, due to entanglement in a commercial salmon drift gillnet near Kenai in 2013, was reported to the NMFS Alaska Region stranding database (Helker et al. 2015). However, this event is accounted for in the extrapolated estimate (derived from Alaska Marine Mammal Observer Program (AMMOP) observer data) of annual mortality and serious injury occurring in the commercial Cook Inlet salmon drift gillnet fishery (in Table 1).

~~**Table 2.** Summary of the Gulf of Alaska stock of harbor porpoise mortalities and serious injuries by year and type reported to the Alaska Regional Office, marine mammal stranding database, for the 2008-2012 period (Allen et al. 2014, Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.~~

~~Cause of Injury~~	**~~2008~~**	**~~2009~~**	**~~2010~~**	**~~2011~~**	**~~2012~~**	**~~Mean Annual Mortality~~**
~~Caught in Cook Inlet salmon gillnet~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0.2~~
~~Minimum total annual mortality~~						~~0.20~~

~~Strandings of marine mammals with fishing gear attached or with injuries caused by interactions with fishing gear are another source of mortality data. In the period from 1990 to 1994, 12 harbor porpoise scarred with gillnet marks were discovered stranded in Prince William Sound (Copper River Delta; NMFS Alaska Regional Office, Marine Mammal Stranding Database). Based on scar patterns, temporal-spatial analysis, and necropsy findings, these strandings were likely the result of the Prince William Sound salmon drift gillnet fishery. The extrapolated (estimated) observer mortality for this fishery accounts for these mortalities, so they do not appear in Table 2. There were no confirmed reports of strandings of fishery-related mortalities of harbor porpoise in this area during 2008-2012.~~

A ~~reliable~~complete estimate of the total ~~number of mortalities~~mortality and serious injury incidental to commercial fisheries is unavailable because of the absence of observer placements in ~~several~~all salmon ~~gillnet~~and herring fisheries. However, the estimated minimum annual mortality and serious injury rate incidental to U.S. commercial fisheries is ~~71.4~~72 harbor porpoise (Table 1).

Alaska Native Subsistence/~~Native~~ Harvest Information

Porpoise in the Gulf of Alaska were hunted by prehistoric societies in Kodiak, Cook Inlet, and Prince William Sound (Shelden et al. 2014). Subsistence hunters ~~in Alaska~~ have not been reported to ~~take~~harvest from this stock of harbor porpoise since the early1900s (Shelden et al. 2014).

~~**Other Mortality**~~

~~Harbor porpoises occasionally become entangled in subsistence gillnets, although the frequency of occurrence is not well known. In 1995, two harbor porpoise were taken incidentally in subsistence gillnets, one near Homer Spit and the other near Port Graham.~~

STATUS OF STOCK

Harbor porpoise are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Because the PBR is ~~unknown~~undetermined, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. The estimated annual level of human-caused mortality and serious injury is ~~71.4~~72 harbor porpoise. Because the most recent abundance estimate is more than 8 years old and information on incidental harbor porpoise mortality and serious injury in commercial fisheries is not ~~well understood~~complete, the Gulf of Alaska stock of harbor porpoise is classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population~~OSP~~ are currently unknown.

HABITAT CONCERNS

~~Most h~~Harbor porpoise are mostly found in waters less than 100 m in depth and they often concentrate in near-shore areas, bays, tidal areas, and river mouths (Dahlheim et al. 2000, Hobbs and Waite 2010). As a result, harbor porpoise are vulnerable to physical modifications of nearshore habitats resulting from urban and industrial development (including waste management and nonpoint source runoff) and activities such as construction of docks and other over-~~-~~water structures, filling of shallow areas, ~~and~~ dredging, and noise (Linnenschmidt et al. 2013).

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Revised ~~10/09/2014~~9/8/2015

HARBOR PORPOISE (*Phocoena phocoena*): Bering Sea Stock

NOTE – ~~March 2008~~July 2015: In areas outside of Alaska, studies of harbor porpoise distribution have ~~shown~~indicated that stock structure is likely more finely-scaled than is reflected in the Alaska Stock Assessment Reports. At this time, no data are available to define stock structure for harbor porpoise on a finer scale in Alaska. However, based on comparisons with other regions, ~~smaller stocks are~~it is likely that several regional and sub-regional populations exist. Should new information on harbor porpoise stocks become available, the harbor porpoise Stock Assessment Reports will be updated.

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, the harbor porpoise ranges from Point Barrow and offshore areas of the Chukchi Sea, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984, Christman and Aerts 2015). Harbor porpoise primarily frequent the coastal waters ~~and in~~of the Gulf of Alaska and Southeast Alaska (Dahlheim et al. 2000, 2009), ~~they~~typically occurring ~~most frequently~~ in waters less than 100 m deep (Hobbs and Waite 2010). The average density of harbor porpoise in Alaska appears to be less than that reported off the west coast of the continental U.S., although areas of high densities do occur in Glacier Bay and the adjacent waters of Icy Strait, Yakutat Bay, the Copper River Delta, ~~and~~ Sitkalidak Strait (Dahlheim et al. 2000, Hobbs and Waite 2010), and lower Cook Inlet (Shelden et al. 2014).

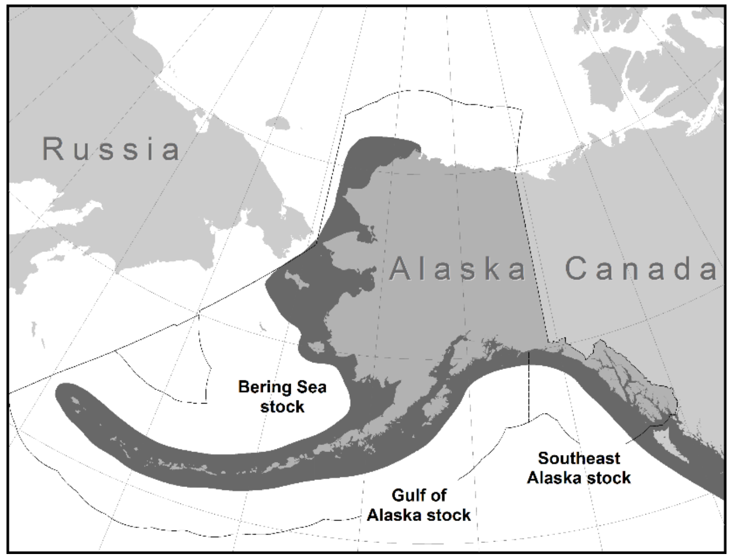

Figure 1. Approximate distribution of harbor porpoise in Alaska waters (dark shaded area).

Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the w~~W~~est c~~C~~oast (Rosel 1992), including one sample from Alaska. Two distinct mitochondrial DNA groupings or clades were found. One clade is present in California, Washington, British Columbia, and the single sample from Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border also suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991); these results are reinforced by a similar study in the northwest Atlantic (Westgate and Tolley 1999). Further genetic testing of the same samples mentioned above, along with a few additional samples including ~~8~~eight more from Alaska, found significant genetic differences for three of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel et al. 1995). Those results demonstrate that harbor porpoise along the west coast of North America are not panmictic~~,~~ and that movement is sufficiently restricted to result in genetic differences. This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic (Rosel et al. 1999). Numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles (Walton 1997). In a molecular genetic analysis of small-scale population structure of eastern North Pacific harbor porpoise, Chivers et al. (2002) included 30 samples from Alaska, 16 of which were from Copper River Delta, 5 from Barrow, 5 from Southeast Alaska, and 1 sample each from St. Paul, Adak, Kodiak, and Kenai. Unfortunately, no conclusions could be drawn about the genetic structure of harbor porpoise within Alaska because of the insufficient number of samples from each region. Accordingly, harbor porpoise stock structure in Alaska is unknown at this time.

Although it is difficult to determine the true stock structure of harbor porpoise populations in the northeast Pacific, from a management standpoint~~,~~ it would be prudent to assume that regional populations exist and that they should be managed independently (Rosel et al. 1995, Taylor et al. 1996). The Alaska Scientific Review Group concurred that ~~while the~~ available data were insufficient to justify recognizing three biological stocks of harbor porpoise in Alaska instead of only one; however, it did not recommend against the establishment of three management units in Alaska (DeMaster 1996, 1997). Accordingly, from the above information, three harbor porpoise stocks in Alaska ~~are~~were ~~recommended~~identified, recognizing that the boundaries of these three stocks were inferred primarily based upon geography or perceived areas of low porpoise density~~were set based on geography~~: 1) the Southeast Alaska stock - occurring from the northern border of British Columbia to Cape Suckling, Alaska, 2) the Gulf of Alaska stock - occurring from Cape Suckling to Unimak Pass, and 3) the Bering Sea stock - occurring throughout the Aleutian Islands and all waters north of Unimak Pass (Fig. 1). To date, there have been no analyses to assess the validity of these stock designations.

Harbor porpoise~~s~~ have been sighted during seismic surveys of the Chukchi Sea conducted in the nearshore and offshore waters by the oil and gas industry between July and November from 2006 to 2010 (~~Aerts et al. 2011;~~ Funk et al. 2010, 2011; Aerts et al. 2011; Reiser et al. 2011). Harbor porpoise were the third most frequently sighted cetacean species in the Chukchi Sea, after gray and bowhead whales, with most sightings occurring during the September-October monitoring period (Funk et al. 2011, Reiser et al. 2011). Over the 2006-2010 industry-sponsored monitoring period, six sightings of 11 harbor porpoise~~s~~ were reported in the Beaufort Sea, suggesting harbor porpoise ~~are~~ regularly occur~~ring more regularly in small numbers~~ in both the Chukchi and Beaufort Seas (Funk et al. 2011).

POPULATION SIZE

In June and July of 1999, an aerial survey covered the waters of Bristol Bay. Two types of corrections were needed for these aerial surveys: one for observer perception bias to correct for animals not counted because they were not observed and one to correct for porpoise availability/visibility at the surface. The 1999 survey resulted in an observed abundance estimate for the Bering Sea harbor porpoise stock of 16,289 (CV = 0.132; Hobbs and Waite 2010),~~. The observed abundance estimate~~ which includes ~~a~~the perception bias correction factor (1.337; CV = 0.062) ~~for perception bias to correct for animals not counted because they were not observed~~obtained during the survey using an independent belly window observer. Laake et al. (1997) estimated the availability bias for aerial surveys of harbor porpoise in Puget Sound to be 2.96 (CV = 0.180); the use of this correction factor is preferred to other published correction factors (e.g., Barlow et al. 1988, Calambokidis et al. 1993) because it is an empirical estimate of availability bias. ~~The estimated~~Applying this second correction factor, the corrected abundance estimate is 48,215 (16,289 × 2.96 = 48,215; CV = 0.223). The estimate for 1999 can be considered conservative for that time period, as the surveyed areas did not include known harbor porpoise range near either the Pribilof Islands or in the waters north of Cape Newenham (approximately 59°N).~~ However, because the survey data are now more than 8 years old, it is not considered a reliable minimum population estimate for calculating a PBR.~~

Shipboard visual line-transect surveys for cetaceans were conducted on the eastern Bering Sea shelf in association with pollock stock assessment surveys in June and July of 1999, 2000, 2002, 2004, 2008, and 2010 (Moore et al. 2002; Friday et al. 2012, 2013). The entire range of the survey was completed in three of those years (2002, 2008, and 2010) and harbor porpoise abundance estimates were calculated for each of these surveys (Friday et al. 2013); however, correction factors were not applied for perception bias, availability bias, or responsive movement to the ship. The abundance estimate was 1,971 (CV = 0.46) for 2002, 4,056 (CV = 0.40) for 2008, and 833 (CV = 0.66) for 2010. Although the 2010 estimate is the lowest of the three years, it is not significantly different from the 2002 and 2008 estimates (Friday et al. 2013). These surveys are useful for showing distribution throughout the southeastern Bering Sea and the relationship to hydrographic domains; however, because the surveys were not designed for harbor porpoise and no correction factors are available, the abundance estimates are not used to calculate a population estimate.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the potential biological removal (PBR) ~~G~~guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the 1999 population estimate (N) of 48,215 and its associated CV of 0.223, N_{MIN} for the Bering Sea stock of harbor porpoise is 40,039 (Hobbs and Waite 2010). However, because the survey data are more than 8 years old, N_{MIN} is considered unknown.

Current Population Trend

The abundance of harbor porpoise in Bristol Bay was estimated in 1991 and 1999. The 1991 estimate was 10,946 (Dahlheim et al. 2000). The 1999 estimate of 48,215 is higher than the 1991 estimate (Hobbs and Waite

2010). However, there are some key differences between surveys which complicate direct comparisons. Transect lines were substantially more dense in 1999 than in 1991 and large numbers of porpoise were observed in 1999 in an area which was not surveyed intensely in 1991 (compare sightings in northeast Bristol Bay depicted in Figure 5 in Hobbs and Waite (2010) with Figure 4 in Dahlheim et al. 2000). In addition, the use of a second correction factor for the 1999 estimate confounds direct comparison. The density of harbor porpoise resulting from the 1999 surveys was still substantially higher than that from 1991 (Dahlheim et al. 2000), but it is unknown whether the increase in density is a result of a population increase or ~~is~~ a result of survey design. Thus, at present, there is no reliable information on trends in abundance for the Bering Sea stock of harbor porpoise.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate (R_{MAX}) is not currently available for this stock of harbor porpoise. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate of 4% be employed (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the ~~potential biological removal (~~PBR~~)~~ is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). However, the 2005 revisions to the SAR guidelines (Wade and Angliss 1997) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate (NMFS 2005). Therefore, the PBR for this stock is considered undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~**New Serious Injury Guidelines**~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Prior to 2003, three different federally-managed commercial fisheries operating within the range of the Bering Sea stock of harbor porpoise were monitored for incidental take by NMFS observers during 1990-1998: the Bering Sea/~~ (and~~ Aleutian Islands~~)~~ groundfish trawl, longline, and pot fisheries. As of 2003, changes in fishery definitions in the MMPA List of Fisheries resulted in separating these fisheries into 12 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort~~,~~ but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. ~~There were n~~No mortality or serious injury of Bering Sea harbor porpoise ~~mortalities from the Bering Sea stock reported~~was observed in these commercial fisheries during ~~2008-2012~~2009-2013.

One harbor porpoise mortality due to entanglement in a commercial salmon gillnet in Kotzebue was reported to the NMFS Alaska Region stranding database in 2013 (Helker et al. 2015), resulting in a minimum average annual mortality and serious injury rate of 0.2 Bering Sea harbor porpoise in commercial fisheries in 2009-2013.~~The estimated minimum annual mortality rate incidental to commercial fisheries is 0 animals.~~ However, a reliable estimate of the mortality and serious injury rate incidental to commercial fisheries is currently unavailable because of the absence of observer placements in ~~several~~all of the salmon ~~gillnet~~and herring fisheries. Therefore, it is unknown whether the ~~kill~~mortality and serious injury rate is insignificant.

In 2012, one harbor porpoise entangled in a subsistence salmon gillnet in Nome, AK (Helker et al. 2015), resulting in an average annual mortality and serious injury rate of 0.2 harbor porpoise due to subsistence fishery interactions in 2009-2013 (Table 1).~~A single report of a harbor porpoise entanglement in a subsistence gillnet occurred in 2012 (mean annual mortality = 0.2) (Table 1).~~

Table 1. Summary of incidental mortality and serious injury of the Bering Sea stock of harbor porpoise ~~mortalities and serious injuries~~, by year and type, reported to the NMFS Alaska Region~~al Office~~, marine mammal stranding database, ~~for the 2008-2012 period~~in 2009-2013 (~~Allen et al. 2014,~~ Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of ~~I~~injury	**~~2008~~**	**2009**	**2010**	**2011**	**2012**	**2013**	**Mean ~~A~~annual ~~M~~mortality**
Entangled in subsistence salmon gillnet	~~0~~	0	0	0	1	0	0.2
~~Minimum total annual mortality~~							~~0.20~~

Alaska Native Subsistence/~~Native~~ Harvest Information

~~There have been historic reports of harbor porpoise mortalities from bycatch in subsistence gillnets in the area from Nome to Unalakleet (Barlow et al. 1994) and near Point Barrow (Suydam and George 1992). Bee and Hall (1956) reported on two entanglements in subsistence nets in Elson Lagoon, near Barrow, in 1952. More recently, subsistence fishermen in Barrow state that it is not uncommon for one or two porpoise to be caught each summer (Suydam and George 1992). In 1991, pack ice may have contributed to the relatively high number (4) of porpoise caught in subsistence nets (Suydam and George 1992). One confirmed report of an entangled animal near Emmonak occurred between 1999 and 2003, and in 2007, 2 harbor porpoise were found dead in a subsistence net in Nome, AK (NMFS, Alaska Regional Office, Marine Mammal Stranding Database).~~Subsistence hunters in Alaska have not been reported to hunt from this stock of harbor porpoise; however, when porpoise are caught incidental to subsistence or commercial fisheries, subsistence hunters may claim the carcass for subsistence use (R. Suydam, North Slope Borough, pers. comm.).

STATUS OF STOCK

Harbor porpoise are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Because the PBR is ~~unknown~~undetermined, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. The minimum estimate of mean annual mortality and serious injury (~~0~~ 0.2 from commercial fisheries ~~and~~+ 0.2 from subsistence fisheries) is ~~0.2~~0.4; the estimated annual level of human-caused mortality and serious injury relative to PBR is unknown. Because the abundance estimates are more than 8 years old and information on incidental mortality and serious injury in commercial fisheries is sparse, the Bering Sea stock of harbor porpoise is classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population~~OSP~~ are currently unknown.

HABITAT CONCERNS

~~Most h~~Harbor porpoise are mostly found in waters less than 100 m in depth ~~and often concentrate in near-shore areas, bays, tidal areas and river mouths~~(Dahlheim et al. 2000, Hobbs and Waite 2010). As a result, harbor porpoise are ~~more~~ vulnerable to ~~nearshore~~ physical ~~habitat~~ modifications of nearshore habitats resulting from urban and industrial development~~,~~ (including waste management~~,~~ and nonpoint source runoff)~~,~~ and ~~physical habitat modifications including~~activities such as construction of docks and other over-~~-~~water structures, filling of shallow areas, ~~and~~ dredging, and noise (Linnenschmidt et al. 2013). Climate change and changes to sea-ice coverage may be opening up new habitats, or resulting in shifts in habitat, as evident by an increase in the number of reported sightings of harbor porpoise~~s~~ in the Chukchi Sea (Funk et al. 2010, 2011). Shipping and noise from oil and gas activities may also be a habitat concern for harbor porpoise~~s~~, particularly in the Chukchi Sea.

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DALL'S PORPOISE (*Phocoenoides dalli*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Dall's porpoise are widely distributed across the entire North Pacific Ocean (Fig. 1). They are found over the continental shelf adjacent to the slope and over deep (2,500+ m) oceanic waters (Hall 1979). They have been sighted throughout the North Pacific as far north as 65°N (Buckland et al. 1993)~~,~~ and as far south as 28°N in the eastern North Pacific (Leatherwood and Fielding 1974). The only apparent distribution gaps in Alaska waters are upper Cook Inlet and the shallow eastern flats of the Bering Sea. Throughout most of the eastern North Pacific they are present during all months of the year, although there may be seasonal onshore-offshore movements along the west coast of the continental U.~~nited~~ S.~~tates~~ (Loeb 1972, Leatherwood and Fielding 1974)~~,~~ and winter movements of populations out of areas with ice such as Prince William Sound (Hall 1979) ~~and areas in the Gulf of Alaska and Bering Sea (NMFS, unpubl. data, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115)~~.

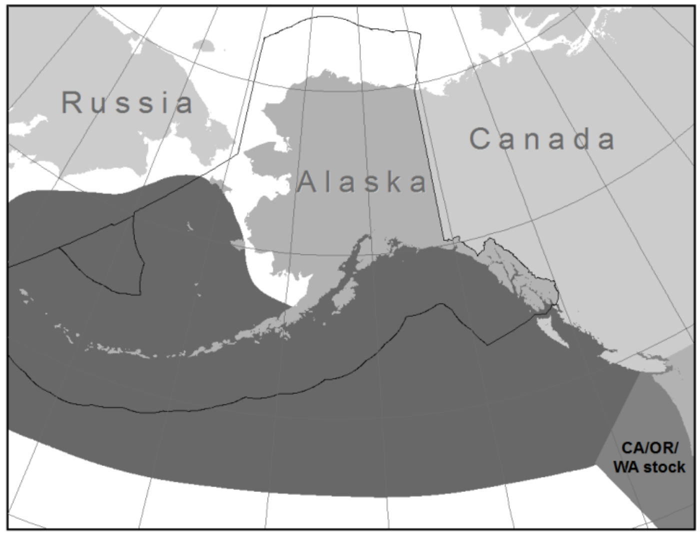

Figure 1. Approximate distribution of Dall's porpoise in Alaska waters (dark shaded area).

Surveys ~~in~~on the ~~central-eastern and south~~eastern Bering Sea shelf and slope to the 1,000 m isobath in 1999,~~ and~~ 2000, 2002, 2004, 2008, and 2010 ~~(see Fig. 1 in the Northeast Pacific fin whale SAR for locations of surveys) resulted in new~~provided information about the distribution and relative abundance of Dall's porpoise in ~~these~~this area~~s~~ (Moore et al. 2002; Friday et al. 2012, 2013). Dall's porpoise were sighted on the shelf and slope in waters deeper than 100 m in 2002, 2008, and 2010 with greater densities at the shelf break than in shallower waters~~were abundant in both areas, were consistently found in deeper water (286 m, SE = 23 m) than harbor porpoise (67 m; SE = 3 m; t-test, P<0.0001) and were particularly clustered around the shelf break in the central-eastern Bering Sea~~ (~~Moore et al. 2002~~Friday et al. 2013).

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous;~~,~~ 2) Population response data: differential timing of reproduction between the Bering Sea and western North Pacific; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. The stock structure of eastern North Pacific Dall's porpoise is not adequately understood at this time, but based on patterns of stock differentiation in the western North Pacific, where they have been more intensively studied, it is expected that separate stocks will emerge when data become available (Perrin and Brownell 1994). Based primarily on the population response data (Jones et al. 1986) and preliminary genetics analyses (Winans and Jones 1988), a delineation between Bering Sea and western North Pacific stocks has been recognized. However, similar data are not available for the eastern North Pacific~~,~~; thus, one stock of Dall's porpoise is recognized in Alaskan waters. Dall's porpoise along the west coast of the continental U.S. from California to Washington comprise a separate stock and are reported separately in the Stock Assessment Reports for the U.S. Pacific Region.

POPULATION SIZE

Data collected from vessel surveys, performed by both U.S. fishery observers and U.S. researchers from 1987 to 1991, were analyzed to provide population estimates of Dall's porpoise throughout the North Pacific and the Bering Sea (Hobbs and Lerczak 1993). The quality of data used in analyses was determined by the procedures recommended by Boucher and Boaz (1989). Survey effort was not well distributed throughout the U.S. Exclusive Economic Zone (EEZ) in Alaska~~,~~ and, as a result, Bristol Bay and the northern Bering Sea received little survey effort. Only ~~3~~three sightings were reported between 1987 ~~to~~and 1991 in this area by Hobbs and Lerczak (1993), resulting in an estimate of 9,000 (CV = 0.91). In the U.S. EEZ north and south of the Aleutian Islands, Hobbs and Lerczak (1993) reported an estimated abundance of 302,000 (CV = 0.11), whereas, for the Gulf of Alaska EEZ, they reported 106,000 (CV = 0.20). Combining these three estimates (9,000 + 302,000 + 106,000) results in a total abundance estimate of 417,000 (CV = 0.097) for the Alaska stock of Dall's porpoise. Turnock and Quinn (1991) estimate that abundance estimates of Dall's porpoise are inflated by as much as ~~5~~five times because of vessel attraction behavior. Therefore, a corrected population estimate from 1987-1991 is 83,400 (417,000 × 0.2) for this stock. Surveys for this stock are ~~greater~~more than ~~21~~8 years old, consequently there ~~is~~are no reliable abundance data for the Alaska stock of Dall's porpoise. No reliable abundance estimates for British Columbia are currently available.

Sighting surveys for cetaceans were conducted during ~~a~~ NMFS pollock ~~acoustic~~stock assessment surveys in 1999, 2000, 2002, ~~and~~ 2004, 2008, and 2010 on the eastern Bering Sea shelf (Moore et al. 2002; Friday et al. 2012, 2013). The entire range of the survey was completed in three of those years (2002, 2008, and 2010) and Dall's porpoise estimates were calculated for each of these surveys (Friday et al. 2013). The abundance estimate was 35,303 (CV = 0.53) in 2002, 14,543 (CV = 0.32) in 2008, and 11,143 (CV = 0.32) in 2010. Although the 2010 estimate is the lowest of the three years, it is not significantly different from the 2002 and 2008 estimates (Friday et al. 2013).~~The area was stratified into northern and southern regions determined by the survey legs of the pollock survey, and oceanographic domains within each (Friday et al. in press). Pooling the northern domains, abundance for Dall's porpoise was estimated to be 12,486 (CV = 0.38) in 1999 and 14,597 (CV=0.27) in 2002 (the northern regions were not surveyed in 2000 and 2004). Pooling the southern domains, the abundance for Dall's porpoise was estimated to be 13,012 (CV = 0.45) in 2000, 26,922 (CV = 0.92) in 2002, and 6,478 (CV = 0.36) in 2004 (the southern region were not surveyed in 1999).~~ These estimates have not been corrected for animals missed on the trackline (perception bias) or animals submerged when the ship passed (availability bias). They are also uncorrected for potential biases from responsive movements (ship attraction) and are, therefore, not used as minimum population estimates.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated using Equation 1 from the potential biological removal (PBR) ~~G~~guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. However, since the abundance estimate is based on data older than 8 years, the N_{MIN} is considered unknown.

Current Population Trend

At present, there is no reliable information on trends in abundance for the Alaska stock of Dall's porpoise.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is not currently available for the Alaska stock of Dall's porpoise. Hence, until additional data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for the Alaska stock of Dall's porpoise (Wade and Angliss 1997). However, based on life history analyses in Ferrero and Walker (1999), Dall's porpoise reproductive strategy is not consistent with the delphinid pattern on which the default R_{MAX} for cetaceans is based. In contrast to the delphinids, Dall's porpoise mature earlier and reproduce annually which suggest that a higher R_{MAX} may be warranted~~, pending further analyses~~.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the ~~potential biological removal (~~PBR~~)~~ is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. ~~This stock was considered to be within optimum sustainable population (Buckland et al. 1993), thus the recovery factor (F_R) for this stock was 1.0 (Wade and Angliss 1997). However, the PBR level is currently unknown. The estimate of abundance for Dall's porpoise is now more than 8 years old;~~ Wade and Angliss (1997) recommend that abundance estimates older than 8 years no longer be used to calculate a PBR level; ~~. T~~thus, because the abundance estimate for this stock is ~~quite~~more than 8 years old, the N_{MIN} is unknown and therefore the PBR level is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Until 2003, there were six different federally-regulated commercial fisheries in Alaska that could have interacted with Dall's porpoise and were monitored for incidental mortality and serious injury by fishery observers. As of 2003, changes in fishery definitions in the MMPA List of Fisheries have resulted in separating these 6~~six~~ fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort~~,~~ but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. For the fisheries with observed takes, the range of observer coverage ~~over the 4-year period (2007-2010)~~in 2009-2013, as well as the annual observed and estimated mortality~~ies~~ and serious injury, are presented in Table 1.

The Alaska Peninsula/~~ and~~ Aleutian Islands salmon drift gillnet fishery was monitored in 1990~~. Observers were onboard 59 (38.3%) of the 154 vessels participating in the fishery, monitoring a total of 373 sets, or less than 4% of the estimated number of sets made by the fleet~~ (Wynne et al. 1991). One Dall's porpoise mortality was observed, which extrapolated to an annual (total) incidental mortality and serious injury rate of 28 Dall's porpoise (Table 1). ~~Combining the estimates from the Bering Sea and Gulf of Alaska fisheries (0.69) with the estimate from the Alaska Peninsula and Aleutian Island salmon drift gillnet fishery (28) results in an estimated annual incidental kill rate in observed fisheries of 28.7 porpoise per year from this stock.~~

~~The Prince William Sound salmon drift gillnet fishery was also monitored by observers during 1990 and 1991, with no incidental mortality of Dall's porpoise reported. In 1990, observers boarded 300 (57.3%) of the 524 vessels that fished in the Prince William Sound salmon drift gillnet fishery, monitoring a total of 3,166 sets, or roughly 4% of the estimated number of sets made by the fleet (Wynne et al. 1991). In 1991, observers boarded 531 (86.9%) of the 611 registered vessels and monitored a total of 5,875 sets, or roughly 5% of the estimated sets made by the fleet (Wynne et al. 1992).~~In 2012 and 2013, the Alaska Marine Mammal Observer Program (AMMOP) placed observers on independent vessels in the state-managed Southeast Alaska salmon drift gillnet fishery to assess mortality and serious injury of marine mammals. Areas around and adjacent to Wrangell and Zarembo Islands (ADF&G Districts 6, 7, and 8) were observed during the 2012-2013 program (Manly 2015). In 2012, one Dall's porpoise was seriously injured. Based on the one observed serious injury, 18 serious injuries were estimated for Districts 6, 7, and 8 in 2012, resulting in an estimated mean annual mortality and serious injury rate of 9 Dall's porpoise in 2012-2013 (Table 1). Since these three districts represent only a portion of the overall fishing effort in this fishery, we expect this to be a minimum estimate of mortality for the fishery. Note that the AMMOP has not observed the Southeast Alaska salmon drift gillnet fishery in the other districts; additionally, NMFS has not observed several other gillnet fisheries that are known to interact with this stock, therefore, the total estimated mortality and serious injury is unavailable. However, due to the large stock size, it is unlikely that unreported mortality and serious injury from those fisheries are a significant source of mortality. Combining the estimates from the Bering Sea and Gulf of Alaska fisheries (0.5) with the estimate from the Alaska Peninsula/Aleutian Islands salmon drift gillnet fishery (28) and the Southeast Alaska salmon drift gillnet fishery (9) results in an estimated average annual mortality and serious injury rate in observed fisheries of 38 Dall's porpoise per year from this stock.

Table 1. Summary of incidental mortality and serious injury of the Alaska stock of Dall's porpoise ~~(Alaska stock)~~ due to U.S. commercial fisheries from ~~2007 to 2010~~2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Wynne et al. 1991; Breiwick 2013; Manly 2015; NMML, unpubl. data). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Bering Sea/Aleutian Is. ~~(BSAI)~~ pollock trawl	~~2007~~ ~~2008~~ 2009 2010 2011 2012 2013	obs data	~~85~~ ~~85~~ 86% 86% 98% 98% 97%	~~0~~ ~~0~~ 1 0 0 0 0	~~0~~ ~~0~~ ~~1.2~~1.04 0 0 0 0	~~0.31~~0.2 (CV = ~~0.67~~0.19)
Bering Sea/-Aleutian Is. ~~(BSAI)~~ Pacific cod longline	~~2007~~ ~~2008~~ 2009 2010 2011 2012 2013	obs data	~~63~~ ~~63~~ ~~61~~60% 64% 57% 51% 67%	~~0~~ ~~0~~ 1 0 0 0 0	~~0~~ ~~0~~ 1.5 0 0 0 0	~~0.38~~0.3 (CV = 0.77)
~~Gulf of Alaska (GOA) pollock trawl~~	~~2007~~ ~~2008~~ ~~2009~~ ~~2010~~	~~obs data~~	~~27~~ ~~34~~ ~~43~~ ~~29~~	~~0~~ ~~0~~ ~~0~~ ~~0~~	~~0~~ ~~0~~ ~~0~~ ~~0~~	~~0~~
SE Alaska salmon drift gillnet (Districts 6, 7, 8)	2012 2013	obs data	6.4% 6.6%	1 0	18 0	9 (CV = 1.0)
AK Peninsula/-Aleutian Is.~~land~~ salmon drift gillnet	1990	obs data	4%	1	28	28 (~~CI: 1-81~~CV = 0.585)
Minimum total estimated annual mortality						~~28.69~~38 (CV = ~~0.52~~0.498)

~~No incidental takes of Dall's porpoises were recorded in the Cook Inlet salmon driftnet and setnet fisheries (1999-2000), the Kodiak Island salmon set gillnet fishery (2002 and 2005), and Yakutat salmon setnet fishery (2007 and 2008) by the Alaska Marine Mammal Observer Program, although Dall's porpoises were among the species spotted in the area of operations (Manly et al. 2003; Manly 2006, 2007). Note that no observers have been assigned to several of the gillnet fisheries that are known to interact with this stock, making the estimated mortality unreliable. However, due to the large stock size it is unlikely that unreported mortalities from those fisheries are a significant source of mortality.~~

From ~~2006-2010~~2009 to 2013, ~~two entanglements~~no mortality or serious injury of Dall's porpoises ~~have been~~was reported to the NMFS Alaska Region ~~S~~stranding ~~Program~~database (Helker et al. 2015~~NMFS Alaska Regional Office, unpublished data~~). ~~These animals both entangled together in a sockeye salmon gillnet in 2008, with one self-release and one mortality. The mean minimum annual mortality rate of Dall's porpoises based on stranding reports is 0.2.~~

Alaska Native Subsistence/~~Native~~ Harvest Information

There are no reports of subsistence take of Dall's porpoise in Alaska.

STATUS OF STOCK

Dall's porpoise are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. The level of human-caused mortality and serious injury (~~29~~38) is not known to exceed the PBR, which is undetermined as the most recent abundance estimate is more than 8 years old. Because the PBR is undetermined, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. The Alaska stock of Dall's porpoise is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population~~OSP~~ are currently unknown.

HABITAT CONCERNS

While the majority of Dall's porpoise are found throughout the North Pacific, there are also significant numbers found in shelf break and deeper nearshore areas. Thus, they are subject to a variety of habitat impacts. Of particular concern are nearshore areas, bays, channels, and inlets where some Dall's porpoise are vulnerable to physical modifications of nearshore habitats (resulting from urban and industrial development, including waste management and nonpoint source runoff) and noise (Linnenschmidt et al. 2013). Climate change and changes to sea-ice coverage may be opening up new habitats, or resulting in shifts in habitat, as evident by an increase in the number of reported sightings of Dall's porpoise in the Chukchi Sea (Funk et al. 2010, 2011). Shipping and noise from oil and gas activities may also be a habitat concern for Dall's porpoise, particularly in the Chukchi Sea.

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SPERM WHALE (*Physeter macrocephalus*): North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The sperm whale is one of the most widely distributed ~~of any~~ marine mammal species, perhaps ~~only~~ exceeded in its global range only by the killer whale (Rice 1989). In the North Pacific, sperm whales were depleted by extensive commercial whaling over a period of more than a hundred years, and the species was ~~(numerically)~~ the primary target of illegal Soviet whaling in the second half of the 20th century (Ivashchenko et al. 2013, 2014).

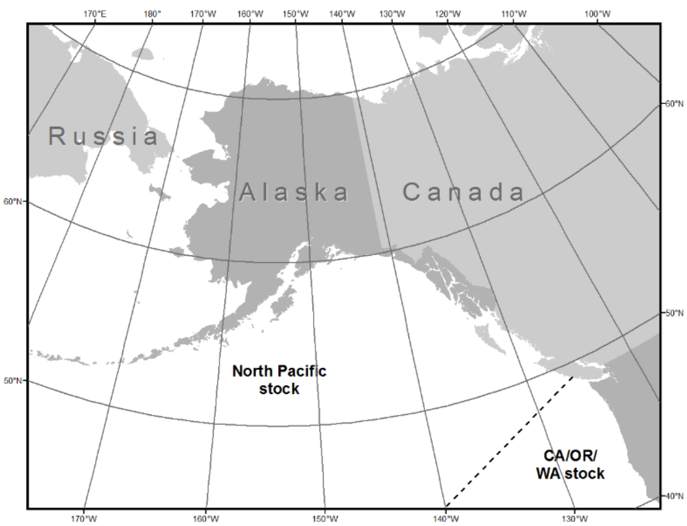

Figure 1. The a~~A~~pproximate distribution of sperm whales in the North Pacific includes deep waters south of 62°N to the equator.

Sperm whales feed primarily on medium-sized to large-sized squids but also take substantial quantities of large demersal and mesopelagic sharks, skates, and fishes (Rice 1989). In the North Pacific, sperm whales are distributed widely (Fig. 1), with the northernmost boundary extending from Cape Navarin (62°N) to the Pribilof Islands (Omura 1955). Although females and young sperm whales were thought to remain in tropical and temperate waters year-round, Mizroch and Rice (2006) and Ivashchenko et al. (2014) showed that there were extensive catches of female sperm whales above 50°N, in the western Bering Sea and in the western Aleutians Islands.~~ and~~ Mizroch and Rice (2013) also show~~ed~~ed female movements into the Gulf of Alaska and western Aleutians~~ and catch concentrations in the western Aleutians~~. Males are found in the summer in the Gulf of Alaska, Bering Sea, and waters around the Aleutian Islands (Kasuya and Miyashita 1988, Mizroch and Rice 2013, Ivashchenko et al. 2014). Sighting~~s~~ surveys conducted by the Alaska Fisheries Science Center's National Marine Mammal Laboratory in the summer months between 2001 and 2010 have found sperm whales to be the most frequently sighted large cetacean in the coastal waters around the central and western Aleutian Islands (NMML, unpubl.~~ished~~ data). Acoustic surveys detected the presence of sperm whales year-round in the Gulf of Alaska although they appear to be more common in summer than in winter (Mellinger et al. 2004). These seasonal detections are consistent with the hypothesis that sperm whales ~~migrate~~move to higher latitudes in summer and ~~migrate~~ to lower latitudes in winter (Whitehead and Arnbom 1987).

Mizroch and Rice (2013) examined 261 Discovery mark recoveries from the days of commercial whaling ~~(recovery data from Omura and Ohsumi 1964, Ivashin and Rovnin 1967, Ohsumi and Masaki 1975, Wada 1980, Kasuya and Miyashita 1988)~~ and found extensive movements from U.S. and Canadian coastal waters into the Gulf of Alaska and Bering Sea. The U.S. marked 176 sperm whales from 1962 to 1969 off southern California and northern Baja California (Mizroch and Rice 2013)~~Rice (AFSC-NMML, retired, pers. comm.) marked 176 sperm whales during U.S. cruises from 1962-1970, mostly between 32° and 36°N off the California coast~~. Seven of those marked whales were recovered in locations ranging from offshore California, Oregon, and British Columbia waters to the western Gulf of Alaska. A male whale marked by Canadian researchers moved from near Vancouver Island, British Columbia, to the Aleutian Islands near Adak. A whale marked by Soviet researchers moved from coastal Michoacán, mainland Mexico, to a location about 1,300 km offshore of Washington ~~s~~State. Similar extensive movements have also been demonstrated by recent satellite-tagging studies (~~J. Straley, Univ. Alaska, Southeast, pers. comm., May 2012~~Straley et al. 2014). Three adult males satellite-tagged off southeastern Alaska moved far south, one to coastal Baja California, one into the north-central Gulf of California, and the ~~other~~third to a location near the Mexico-Guatemala border (~~J. Straley, Univ. Alaska, Southeast, pers. comm., May 2012~~Straley et al. 2014). Marking data show extensive movements throughout the North Pacific and along the U.S. west coast into the Gulf of Alaska and Bering Sea/Aleutian Islands region~~ (BSAI)~~.

Mizroch and Rice (2013) also analyzed whaling data and found that males and females concentrated seasonally along oceanic frontal zones, for example, in the subtropical frontal zone (ca. 28-34°N~~ lat~~) and the subarctic frontal zones (ca. 40-43°N~~ lat~~). Males also concentrated seasonally near the Aleutian Islands and along the Bering Sea shelf edge. Their analyses of marking and whaling data indicate that there are no apparent divisions between separate demes or stocks within the North Pacific. Analysis of Soviet catch data by Ivashchenko et al. (2014) showed broad agreement with these results, although a sharp division was evident at Amchitka Pass in the Aleutians, with mature males to the east and males and family groups to the west, including in the Commander Islands. There were four main areas of concentration in the Soviet catches: a large pelagic area (30-50°N) in the eastern North Pacific, including the Gulf of Alaska and western coast of North America; the northeastern and southwestern central North Pacific; and the southern Kuril Islands. Some of the catch distribution was similar to that of 19th century Yankee whaling catches plotted by Townsend (1935), notably in the "Japan Ground" (in the pelagic western Pacific) and the "Coast of Japan Ground." Many females were caught in Olyutorsky Bay (western Bering Sea) and around the Commander Islands.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: no apparent discontinuities based on whale marking data; 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: genetics studies indicate the possibility of a "somewhat" discrete U.S. coastal stock (Mesnick et al. 2011). For management purposes, the International Whaling Commission (IWC) recognizes two management units of sperm whales in the North Pacific (eastern and western). However, the IWC has not reviewed its sperm whale stock boundaries in recent years (Donovan 1991). For management purposes, three stocks of sperm whales are currently recognized in U.S. waters: 1) Alaska (North Pacific stock), 2) California/Washington/Oregon, and 3) Hawaii. New information from Mizroch and Rice (2013) suggests that this structure should be reviewed and updated to reflect current data. The California/Oregon/Washington and Hawaii sperm whale stocks are reported separately in the Stock Assessment Reports for the U.S. Pacific Region.

POPULATION SIZE

Current and historic estimates ~~for~~of the abundance of sperm whales in the North Pacific are considered unreliable~~. Therefore~~, and caution should be exercised in interpreting published estimates~~ of abundance~~. The abundance of sperm whales in the North Pacific was reported to be 1,260,000 prior to exploitation, which by the late 1970s was estimated to have been reduced to 930,000 whales (Rice 1989). Confidence intervals for these estimates were not provided. These estimates include whales from the California/Oregon/Washington stock, for which a separate abundance estimate is currently available (see Stock Assessment Reports for the U.S. Pacific Region). Estimates for a large area of the eastern temperate North Pacific were produced from line-transect and acoustic survey data by Barlow and Taylor (2005), but no recent estimate exists for other areas, including for the central or western North Pacific.

Although Kato and Miyashita (1998) believe their estimate to be positively biased, their analysis ~~indicates~~suggested 102,112 (CV = 0.155) sperm whales in the western North Pacific. The number of sperm whales ~~of the North Pacific~~ occurring within Alaska waters is unknown.

As the data used in estimating the abundance of sperm whales in the entire North Pacific are ~~over~~more than 8 years old at this time, and there are no available estimates for numbers of sperm whales in Alaska waters, a reliable estimate of abundance for the North Pacific stock is not available.

Minimum Population Estimate

At this time, it is not possible to produce a reliable estimate of minimum abundance for this stock, as a current estimate of abundance is not available.

Current Population Trend

No current estimate of abundance exists for this stock; therefore, reliable information on trends in abundance for this stock is currently not available (Braham 1992).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is not currently available for the North Pacific stock of sperm whales. Hence, until additional data become available, it is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock at this time (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the value for cetacean stocks which are classified as endangered (Wade and Angliss 1997). However, because a reliable estimate of minimum abundance (N_{MIN}) is currently not available, the PBR for this stock is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~**New Serious Injury Guidelines**~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

~~Between 2008 and 2012, there were no observed serious injuries of a sperm whale in the federal commercial groundfish fisheries. The mean annual estimated level of serious injury and mortality of the North Pacific sperm whale stock for 2008-2012 is 0.~~Between 2009 and 2013, there were four serious injuries of sperm whales observed in the Gulf of Alaska sablefish longline fishery (two each in 2012 and 2013), resulting in an average annual observed mortality and serious injury of 0.8 sperm whales in U.S. commercial groundfish fisheries in 2009-2013 (Helker et al. 2015). Extrapolations based on observer effort are not available at this time.

Alaska Native Subsistence/~~Native~~ Harvest Information

Sperm whales have never been reported to be taken by subsistence hunters (Rice 1989).

Other Mortality

Sperm whales were the dominant species killed by the commercial whaling industry as it developed in the North Pacific in the years after the ~~s~~Second World War (Mizroch and Rice 2006, Ivashchenko et al. 2014). Between 1946 and 1967, most of the sperm whales were caught in waters near Japan and in the Bering Sea/Aleutian Islands (BSAI) region. The BSAI catches were dominated by males. After 1967, whalers moved out of the BSAI region and began to catch even larger numbers of sperm whales further south in the North Pacific between 30° and 50°N (Mizroch and Rice 2006~~,~~: Figs. 7-9). The reported catch of sperm whales taken by commercial whalers operating in the North Pacific between 1912 and 2006 was 261,148 sperm whales, of which, 259,120 were taken between 1946 and 1987 (~~International Whaling Commission~~IWC, Bureau of International Whaling Statistics (BIWS) catch data, February 2008 version, unpubl.~~ished~~). This value underestimates the actual kill in the North Pacific as a result of under-reporting by U.S.S.R. pelagic whaling operations. Berzin (2008) described extreme under-reporting and misreporting of Soviet sperm whale catches from the mid-1960s into the early 1970s, including enormous (and underreported) whaling pressure on female sperm whales in the latter years of whaling. More recently, Ivashchenko et al. (2013, 2014) estimate that ~~more than 159,000~~157,680 sperm whales were killed by the U.S.S.R. in the North Pacific between 1948 and 1979, of which 25,175 were unreported; the Soviets also extensively misreported the sex and length of catches. In addition, new information ~~suggests~~indicates that Japanese land-based whaling operations also ~~under-reported~~misreported the number and sex of sperm whale catches during the post-World War II era (Kasuya 1999). The last year that the U.S.S.R. reported catches of sperm whales was in 1979 and the last year that Japan reported substantial catches was in 1987, but Japanese whalers reported catches of 48 sperm whales between 2000 and 2009 (~~International Whaling Commission~~IWC, BIWS catch data, October 2010 version, unpubl.~~ished~~). It should be noted that the reliability of data concerning large pelagic catches of sperm whales by Japan in the North Pacific is unknown, but analysis of length distribution data suggest at least some degree of systematic misreporting (Cooke et al. 1983). Thus, studies that use Japanese data to assess the North Pacific distribution of this species, including by sex, should be interpreted with caution.

From ~~2006-2010~~2009 to 2013, ~~there were 11~~one suspected human-related sperm whale mortality~~ies~~ was reported to the NMFS Alaska Region ~~S~~stranding ~~Program~~database (~~NMFS Alaska Regional Office, unpublished data~~Helker et al. 2015).~~ Human interaction for these cases could not be determined.~~ A beachcast sperm whale was found in 2012 on a beach near Yakutat with a net from an unknown fishery wrapped around its lower jaw. However, due to the advanced decomposition of this whale, the cause of death could not be determined.

Other Issues

NMFS observers aboard longline vessels targeting both sablefish and halibut have documented sperm whales feeding off longline gear in the Gulf of Alaska (Hill and Mitchell 1998, Hill et al. 1999, Perez 2006, Sigler et al. 2008). Fishery observers recorded several instances during 1995-1997 in which sperm whales were deterred by fishermen (i.e., yelling at the whales or throwing seal bombs in the water).

Annual longline surveys have been recording sperm whale predation on catch since 1998 (Hanselman et al. 2008). Sperm whale depredation in the sablefish longline fishery is widespread in the Central and Eastern Gulf of Alaska~~,~~ but rarely observed in the Bering Sea; the majority of interactions occur in the West Yakutat and East Yakutat/Southeast areas (Perez 2006, Hanselman et al. 2008~~, Perez 2006~~). Sigler et al. (2008) analyzed catch data from 1998 to 2004 and found that catch rates were about 2% less at locations where depredation occurred, but the effect was not significant (p = 0.34). Hill et al. (1999) analyzed data collected by fisheries observers in Alaska waters and also found no significant effect on catch. A small, significant effect on catch rates was found in a study using data collected in ~~s~~Southeast Alaska, in which longline fishery catches between sets were compared with sperm whales present and sets with sperm whales absent (3% reduction, t-test, 95% CI of (0.4-5.5%), p = 0.02, Straley et al. 2005). Undamaged catches may also occur when sperm whales are present; in these cases, sperm whales apparently feed off the discard.

STATUS OF STOCK

Sperm whales are listed as "endangered" under the Endangered Species Act of 1973, and therefore designated as "depleted" under the MMPA. As a result, this stock is classified as a strategic stock. However, on the basis of total abundance, current distribution, and regulatory measures that are currently in place, it is unlikely that this stock is in danger of extinction (Braham 1992). Reliable estimates of the minimum population, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population ~~size~~ are currently not available, although the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown.

HABITAT CONCERNS

There are no known habitat issues that are of particular concern for this stock. However, potential concerns include elevated levels of sound from anthropogenic sources (e.g., shipping, military sonars), possible changes in prey distribution with climate change, entanglement in fishing gear, ship strikes due to increased vessel traffic (e.g., from increased shipping in higher latitudes), and oil and gas activities.

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HUMPBACK WHALE (*Megaptera novaeangliae*): Western North Pacific Stock

NOTE – ~~February 2014~~July 2015: The status and population structure of humpback whales in the North Pacific and elsewhere is currently under review by NMFS as part of a global Status Review of the species. ~~Changes to existing management units are being considered as part of this process, notably following analysis of genetic data from the SPLASH project (Baker et al. 2013); however, until the Status Review is published it is inappropriate to change the existing stock designations described here, including for the western North Pacific and central North Pacific populations.~~

STOCK DEFINITION AND GEOGRAPHIC RANGE

The humpback whale is distributed worldwide in all ocean basins. In winter, most humpback whales occur in the subtropical and tropical waters of the Northern and Southern Hemispheres. Humpback whales in the high latitudes of the North Pacific are seasonal migrants that feed on euphausiids and small schooling fishes (Nemoto 1957, 1959; Clapham and Mead 1999). The humpback whale population was considerably reduced as a result of intensive commercial exploitation during the 20th century.

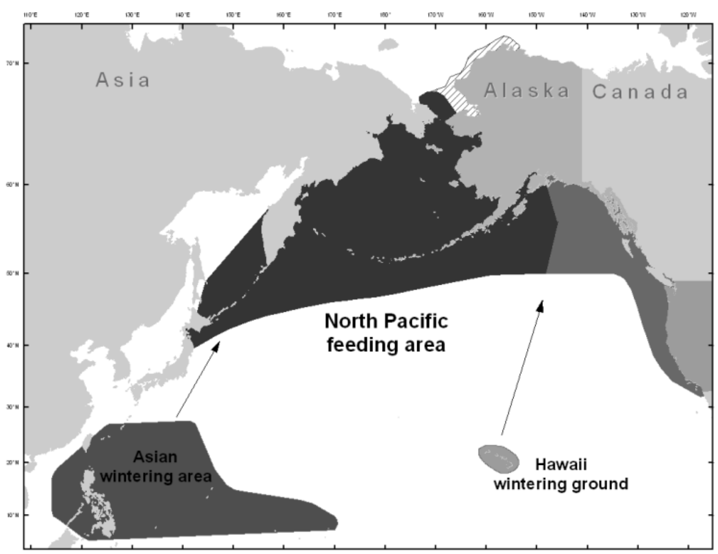

Figure 1. Approximate distribution of humpback whales in the western North Pacific (dark shaded areas). Feeding and wintering grounds are presented above (see text). Area within the hash lines is a probable distribution area based on sightings in the Beaufort Sea (Hashagen et al. 2009). See Figure 1 in the Central North Pacific humpback whale ~~SAR~~Stock Assessment Report for humpback whale distribution in the eastern North Pacific.

A large-scale study of humpback whales throughout the North Pacific was conducted in 2004-2006 (the Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) project). Initial results from this project (Calambokidis et al. 2008, Barlow et al. 2011), including abundance estimates and movement information, have been reported in Baker et al. (2008, 2013)~~,~~ and are also summarized in Fleming and Jackson (2011); however, these results are still being considered for stock structure analysis.

The historic summer feeding range of humpback whales in the North Pacific encompassed coastal and inland waters around the Pacific Rim from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk and north of the Bering Strait (Zenkovich 1954, Nemoto 1957, Tomlin 1967, Johnson and Wolman 1984). Historically, the Asian wintering area extended from the South China Sea east through the Philippines, Ryukyu Retto, Ogasawara Gunto, Mariana Islands, and Marshall Islands (Rice 1998). Humpback whales are currently found throughout this historic range (Clarke et al. 2013b), with sightings during summer months occurring as far north as the Beaufort Sea (Hashagen et al. 2009). Most of the current winter range of humpback whales in the North Pacific is relatively well known, with aggregations of whales in Japan, the Philippines, Hawaii, Mexico, and Central America. The winter range includes the main islands of the Hawaiian archipelago, with the greatest concentration along the west side of Maui. In Mexico, the winter breeding range includes waters around the southern part of the Baja California peninsula, the central portions of the Pacific coast of mainland Mexico, and the Revillagigedos Islands off the mainland coast. The winter range also extends from southern Mexico into Central America, including Guatemala, El Salvador, Nicaragua, and Costa Rica (Calambokidis et al. 2008).

Photo-identification data, distribution information, and genetic analyses have indicated that in the North Pacific there are at least three breeding populations (Asia, Hawaii, and Mexico/Central America) that all migrate between their respective winter/spring calving and mating areas and their summer/fall feeding areas (Calambokidis et al. 1997, Baker et al. 1998). Calambokidis et al. (2001) further suggested that there may be as many as six subpopulations on the wintering grounds. From photo-identification and Discovery tag mark information there are known connections between Asia and Russia, between Hawaii and Alaska, and between Mexico/Central America and California (Darling 1991, Darling and Cerchio 1993, Calambokidis et al. 1997, Baker et al. 1998~~, Darling 1991, Darling and Cerchio 1993~~). This information led to the designation of three stocks of humpback whales in the North Pacific: 1) the California/Oregon/Washington and Mexico stock, consisting of winter/spring populations in coastal Central America and coastal Mexico which migrate to the coast of California to southern British Columbia in summer/fall (Calambokidis et al. 1989, Steiger et al. 1991, Calambokidis et al. 1993); 2) the Central North Pacific stock, consisting of winter/spring populations of the Hawaiian Islands which migrate primarily to northern British Columbia/Southeast Alaska, the Gulf of Alaska, and the Bering Sea/Aleutian Islands (Baker et al. 1990, Perry et al. 1990, Calambokidis et al. 1997); and 3) the Western North Pacific stock, consisting of winter/spring populations off Asia which migrate primarily to Russia and the Bering Sea/Aleutian Islands.

Information from the SPLASH project mostly confirms this view of humpback whale distribution and movements in the North Pacific. For example, the SPLASH results confirm low rates of interchange between the three principal wintering regions (Asia, Hawaii, and Mexico). However, the full SPLASH results suggest the current view of population structure is incomplete. The overall pattern of movements is complex but indicates a high degree of population structure. Whales from wintering areas at the extremes of their range on both sides of the Pacific migrate to coastal feeding areas that are on the same side of the Pacific: whales from Asia in the west migrate to Russia and whales from mainland Mexico and Central America in the east migrate to coastal waters off California~~-~~/Oregon.

The SPLASH data now show the Revillagigedos whales are seen in all sampled feeding areas except northern California~~-~~/Oregon and the south side of the Aleutians, and are primarily distributed in the Bering Sea, Gulf of Alaska, and Southeast Alaska/northern British Columbia, but are also found in Russia and southern British Columbia/Washington. The migratory destinations of humpback whales from Hawaii were found to be quite similar, and a number of matches (14) were seen during SPLASH between Hawaii and the Revillagigedos (Calambokidis et al. 2008). This suggests a need for some modification to the current view of winter breeding populations. After a Status Review under the Endangered Species Act, NMFS has proposed designating four Distinct Population Segments (DPS) of humpback whales in the North Pacific: Western North Pacific, Hawaii, Mexico, and Central America (https://www.federalregister.gov/articles/2015/04/21/2015-09010/endangered-and-threatened-species-humpback-whale-megaptera-novaeangliae-identification-of-14). If this proposed rule results in the designation of DPSs in the North Pacific, ~~A~~a parallel revision of MMPA population structure in the North Pacific~~, possibly similar to the structure based on summer feeding areas for the Atlantic population,~~ will be considered~~ when the full genetic results from the SPLASH project are available~~.

The winter distribution of humpback whales in the western stock includes several island chains in the western North Pacific. In the Ogasawara Islands, humpback sampling during SPLASH was conducted at the three main island groups of Chichi-jima, Haha-jima, and Muko-jima, separated from each other by ~50-70 km. SPLASH sampling in Okinawa (southwest of Honshu) occurred at the Okinawa mainland and Zamami in the Kerama Islands (40 km from the Okinawa mainland), and in the Philippines SPLASH sampling occurred only at the northern tip of the archipelago around the Babuyan Islands. Humpback whales are reported to also occur in the South China Sea north of the Philippines near Taiwan, and east of Ogasawara in the Marshall and Marianas Islands (Rice 1998), but as yet there are no known areas of high density in these regions that could be efficiently sampled.

A relevant finding from the SPLASH project is that whales from the Aleutian Islands, and perhaps also the Gulf of Anadyr in Russia and the Bering Sea, have an unusually low re-sighting rate in winter areas compared to whales from other feeding areas.~~ To a lesser extent this is also true of whales from the Gulf of Anadyr in Russia and the Bering Sea.~~ One explanation for this result could be that some of these whales have a winter migratory destination that was not sampled during the SPLASH project. Given the location of these feeding areas, the most parsimonious explanation would be that some of these whales winter somewhere between Hawaii and Asia, which would include the possibility of the Marianas Islands (southwest of the Ogasawara Islands), the Marshall Islands (approximately half-way between the Marianas and Hawaiian Islands), and the Northwestern Hawaiian Islands. Indeed, humpback whales have been found to occur in the Northwestern Hawaiian Islands, though apparently at relatively low density (Johnston et al. 2007), but n~~N~~o other areas with high densities of humpback whales are known between the Hawaiian main islands and Ogasawara~~, but this could be due to a lack of search effort~~.

The migratory destination of western North Pacific humpbacks is not completely known. Discovery tag recaptures have indicated movement of whales between Ogasawara and Okinawa and feeding areas in the Bering Sea, on the southern side of the Aleutian Islands, and in the Gulf of Alaska (~~Nishiwaki 1966,~~ Omura and Ohsumi 1964, Nishiwaki 1966, Ohsumi and Masaki 1975). Research on humpback whales at the Ogasawara Islands has documented recent movements of whales between there and British Columbia (Darling et al. 1996), the Kodiak Archipelago in the central Gulf of Alaska (Calambokidis et al. 2001), and the Shumagin Islands in the western Gulf of Alaska (Witteveen et al. 2004), but no photo-identification studies had previously been conducted in Russia. Individual movement information from the SPLASH study documents that Russia is likely the primary migratory destination for whales in Okinawa and the Philippines but also reconfirms that some Asian whales go to Ogasawara, the Aleutian Islands, Bering Sea, and Gulf of Alaska (Calambokidis et al. 2008). A small amount of inter-yearly interchange was also found between the wintering areas (Philippines, Okinawa, and Ogasawara).

During the SPLASH study in Russia, humpback whales were primarily found along the Pacific east side of the Kamchatka Peninsula, near the Commander Islands between Kamchatka and the Aleutians Islands, and in the Gulf of Anadyr just southwest of the Bering Strait. Analysis of whaling data shows historical catches of humpback whales well into the Bering Sea and catches in the Bering Strait and Chukchi Sea from August-October in the 1930s (Mizroch and Rice 2007), but no survey effort occurred during SPLASH north of the Bering Strait. Humpback whales are increasingly seen north of the Bering Strait into the northeastern Chukchi Sea (Clarke et al. 2013a, 2013b) with some indication that more humpback whales are seen on the Russian side north of the Bering Strait (Clarke et al. 2013b). Humpback whales are the most commonly recorded cetacean on hydrophones just north of the Bering Strait and occurred from September into early November from 2009 to 2012 (K. Stafford, pers comm.). Other locations in the far western Pacific where humpback whales have been seen in summer include the northern Kuril Islands (V. Burkanov, AFSC, ~~-~~NMML, pers. comm.), far offshore southeast of the Kamchatka Peninsula and south of the Commander Islands (Miyashita 2006), and along the north coast of the Chukotka Peninsula in the Chukchi Sea (Melnikov 2000).

These results indicate humpback whales from the ~~w~~Western North Pacific (Asian) breeding stock overlap broadly on summer feeding grounds with whales from the ~~c~~Central North Pacific breeding stock, as well as with whales that winter in the Revillagigedos in Mexico. Given the relatively small size of the Asian population, Asian whales probably represent a small fraction of all the whales found in the Aleutian Islands, Bering Sea, and Gulf of Alaska, which are primarily whales from Hawaii and the Revillagigedos. The only feeding area that appears to be primarily (or exclusively) composed of Asian whales is along the Kamchatka Peninsula in Russia. The ~~initial~~ SPLASH abundance estimate~~s~~ for Asia ~~ranged from about 900-1,100, and the estimates for~~is similar to the estimate for Kamchatka in Russia~~ ranged from about 100-700~~, suggesting a large portion of the Asian population ~~occurs near~~migrates to Kamchatka. This also shows that Asian whales that migrate to feeding areas besides Russia would be only a small fraction of the total number of whales in those areas, given the much larger abundance estimates for the Bering Sea and Aleutian Islands ~~(6,000-14,000)~~ and the Gulf of Alaska ~~(3,000-5,000)~~ (Calambokidis et al. 2008). A full description of the distribution and density of humpback whales in the Aleutian Islands, Bering Sea, and Gulf of Alaska is in the Stock Assessment Report for the Central North Pacific stock of humpback whales.

In summary, information from a variety of sources indicates that humpback whales from the Western and Central North Pacific stocks mix to a limited extent on summer feeding grounds ranging from British Columbia through the central Gulf of Alaska and up to the Bering Sea.

POPULATION SIZE

In the SPLASH study, fluke photographs were collected by over 400 researchers in all known feeding areas from Russia to California and in all known wintering areas from Okinawa and the Philippines to the coast of Central America and Mexico during 2004-2006. Over 18,000 fluke identification photographs were collected, and these have been used to estimate the abundance of humpback whales in the entire North Pacific Basin. A total of 566 unique individuals were seen in the Asian wintering areas during the 2-year period (3 winter field seasons) of the SPLASH study. Based on a comparison of all winter identifications to all summer identifications, the Chapman-Petersen estimate of abundance is 21,808 (CV=0.04) (Barlow et al. 2011). A simulation study identifies significant biases in this estimate from violations of the closed population assumption (+5.3%), exclusion of calves (-10.3%), failure to achieve random geographic sampling (+1.5%), and missed matches (+9.8%) (Barlow et al. 2011). Sex-biased sampling favoring males in wintering areas does not add significant bias if both sexes are proportionately sampled in the feeding areas. The bias-corrected estimate is 20,800 after accounting for a net positive bias of 4.8%. This estimate is likely to be lower than the true abundance due to two additional sources of bias: individual heterogeneity in the probability of being sampled (un-quantified) and the likely existence of an unknown and un-sampled wintering area (-7.2%).

During the SPLASH study, surveys were conducted in three winter field seasons (2004-2006). The total numbers of unique individuals found in each area during the study were 77 in the Philippines, 215 in Okinawa, and 294 in the Ogasawara Islands. There ~~were~~was a total of 20 individuals seen in more than one area, leaving a total of 566 unique individuals seen in the Asian wintering areas (Calambokidis et al. 2008). For abundance in winter or summer areas, a ~~Hilborn~~multistrata mark-recapture model was used, which is a form of a spatially-stratified model that explicitly estimates movement rates between winter and summer areas (Wade et al. in review). Two broad categories of models were used making different assumptions about the movement rates, and four different models were used for capture probability. ~~Point estimates of abundance for Asia (combined across the three areas) were relatively consistent across models, ranging from 938 to 1,107.~~ The model that fit the data the best (as selected by AICc) gave an estimate of ~~1,107~~893 (CV = 0.079) for the Ogasawara Islands, Okinawa, and the Philippines (Wade et al. in review). ~~Confidence limits or CVs have not yet been calculated for the SPLASH abundance estimates.~~ Although no other high density aggregations of humpback whales are known on the Asian wintering ground, whales have been seen in other locations, indicating this is likely to represent an underestimate of the stock's true abundance to an unknown degree.

On the summer feeding grounds, the ~~initial~~ SPLASH abundance estimate~~s~~ for Kamchatka in Russia ~~ranged from about 100-700~~was 898 (CV = 0.19), suggesting a large portion of the Asian population occurs near Kamchatka (Wade et al. in review). No separate estimates are available for the other areas in Russia, the Gulf of Anadyr and the Commander Islands; abundance from those areas is included in the estimate of abundance for the Bering Sea and Aleutian Islands, which ~~ranged from about 6,000 to 14,000~~was 7,914 (CV = 0.101) (Wade et al. in review). ~~Abundance estimates for the Gulf of Alaska and for Southeast Alaska/northern British Columbia both ranged from 3,000-5,000 (Calambokidis et al. 2008).~~

Minimum Population Estimate

~~As discussed above, point estimates of abundance for Asia ranged from 938 to 1,107 (for 2004 to 2006), but no associated CV has yet been calculated. The 1991-1993 abundance estimate for Asia using similar (though likely less) data had a CV of 0.084. Therefore, it is unlikely the CV of the SPLASH estimate, once calculated, would be greater than 0.300.~~ The minimum population estimate (N_{MIN}) for this stock is calculated according to Equation 1 from the potential biological removal (PBR) ~~G~~guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the SPLASH population estimate (N) of ~~1,107~~893 (CV = 0.079) (Wade et al. in review) ~~from the best fit model and an assumed conservative CV(N) of 0.30 would~~ results in an N_{MIN} for this humpback whale stock of ~~865~~836.

Current Population Trend

The SPLASH abundance estimate for Asia represents a 6.7% annual rate of increase over the 1991-1993 abundance estimate (Calambokidis et al. 2008). However, the 1991-1993 estimate was for Ogasawara and Okinawa only, whereas the SPLASH estimate includes the Philippines, so the annual rate of increase is biased high to an unknown degree.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Utilizing a birth-interval model, Barlow and Clapham (1997) have estimated a population growth rate of 6.5% (SE = 1.2%) for the well-studied humpback whale population in the Gulf of Maine, although there are indications that this rate has slowed in recent years (Clapham et al. 2003). Mobley et al. (2001) estimated a trend of 7% for 1993-2000 using data from aerial surveys that were conducted in a consistent manner for several years across all of the Hawaiian Islands and were developed specifically to estimate a trend for the Central North Pacific stock. Mizroch et al. (2004) estimated survival rates for North Pacific humpback whales using mark-recapture methods, and a Pradel model fit to data from Hawaii for the years 1980-1996 resulted in an estimated rate of increase of 10% per year (95% C~~.~~I: ~~. of~~ 3-16%). For shelf waters of the northern Gulf of Alaska, Zerbini et al. (~~2007~~2006) estimated an annual rate of increase for humpback whales from 1987 to~~-~~ 2003 of 6.6% (95% C~~.~~I: ~~. of~~ 5.2-8.6%). The SPLASH abundance estimate for the total North Pacific represents an annual increase of 4.9% over the most complete estimate for the North Pacific from 1991 to~~-~~ 1993. Comparisons of SPLASH abundance estimates for Hawaii to estimates from 1991 to~~-~~ 1993 gave estimates of annual increase that ranged from 5.5 to 6.0% (Calambokidis et al. 2008). No confidence limits were calculated for these rates of increase from SPLASH data.

Estimates of observed rates of increase can be used to estimate maximum net productivity rates, although in most cases these estimates may be biased low, as maximum net productivity rates are only achieved at very low population sizes. However, if the observed rates of increase are greater than the default value recommended for R_{MAX}, it would be reasonable to use a higher value based on those observations. The rates of increase summarized above include estimates for the North Pacific of 7%, 10%, and 6.6%. Although there is no estimate of the maximum net productivity rate for just the Western stock (i.e., from trends in abundance in the Asia breeding areas), it is reasonable to assume that R_{MAX} for this stock would be at least 7% based on the other observations from the North Pacific. Hence, until additional data become available from the Western North Pacific humpback whale stock, it is recommended that 7% be employed as the maximum net productivity rate (R_{MAX}) for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the ~~potential biological removal (~~PBR~~)~~ is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the value for cetacean stocks listed as endangered under the Endangered Species Act (Wade and Angliss 1997). Using the ~~lowest~~ SPLASH abundance estimate ~~calculated for 2004-2006 of 938 with an assumed CV of 0.300 for the Western North Pacific stock of humpback whale~~of 893 (CV = 0.079) (Wade et al. in review), which results in an N_{MIN} for this humpback whale stock of 836, the PBR is calculated to be ~~3.0~~2.9 animals (~~865~~836 × 0.035 × 0.1).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~New Serious Injury Guidelines~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Between ~~2008 and 2012~~2009 and 2013, there were two known mortalities of ~~Western North Pacific~~ humpback whales in the Bering Sea/Aleutian Islands pollock trawl fishery and one in the Bering Sea/Aleutian Islands flatfish trawl fishery (Table 1). Since the stock identification of these whales is unknown, and the events occurred within the area where the Western North Pacific and Central North Pacific stocks are known to overlap, the mortality in these fisheries is assigned to both stocks of humpback whales. The ~~Average~~ minimum average annual mortality and serious injury rate from observed U.S. commercial fisheries ~~was~~is 0.6 humpbacks from ~~this~~the Western North Pacific stock in 2009-2013 (Table 1).

Table 1. Summary of incidental mortality and serious injury of the Western North Pacific stock of humpback whales ~~(Western North Pacific stock)~~ due to observed U.S. commercial fisheries from ~~2008 to 2012~~2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; NMML, unpubl. data). ~~All events occurred within the area of known overlap with the western and central North Pacific humpback whale stocks. Since the stock identification is unknown, the mortalities and serious injuries are reflected in both stock assessments.~~ ~~Details of how~~Methods for calculating percent observer coverage ~~is measured~~ are ~~included~~described in Appendix 6 of the Alaska Stock Assessment Reports. N/A indicates that data are not available.

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality ~~(in given yrs.)~~	Estimated mortality ~~(in given yrs.)~~	Mean estimated annual mortality
Bering Sea/Aleutian Is. flatfish trawl~~1~~[a]	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~100~~ ~~100~~99% ~~100~~99% ~~100~~99% ~~100~~99% 99%	~~0~~ 0 0 (+1)~~*~~[b] 0 0 0	~~0~~ 0 0 (+1)~~**~~[c] 0 0 0	0.2~~0~~ (CV = N/A)

Fishery name	**Years**	**Data type**	**Percent ~~O~~observer coverage**	**Observed mortality ~~(in given yrs.)~~**	**Estimated mortality ~~(in given yrs.)~~**	**Mean estimated annual mortality**
Bering Sea/Aleutian Is. pollock trawl~~1~~[a]	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~85~~ 86% 86% 98% 98% 97%	~~0~~ 0 1 0 1 0	~~0~~ 0 1.0 0 1.0 0	0.4~~0~~ (CV = ~~0.08~~0.68)~~***~~
Minimum total estimated annual mortality						0.6~~0~~ (CV = ~~0.08~~0.45)

~~1~~[a]Mortality and serious injury in this fishery is assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales, since the stock identification is unknown and the two stocks overlap within the area of operation of the fishery.

~~*~~[b]Total mortalit~~ies~~y and serious injury observed in 2010: 0 in sampled hauls + 1 in an unsampled haul~~s~~.

~~**~~[c]~~Total mortalities observed in sampled and unsampled hauls.~~ Since the total known mortality and serious injury (0 observed in sampled hauls + 1 in an unsampled haul) exceeds the estimated mortality and serious injury (0) for the fishery in 2010, the ~~sum of actual mortalities~~ observed mortality and serious injury (~~1~~in sampled + unsampled hauls) will be used as a minimum estimate for that year.

~~***CV does not accommodate the 2012 data.~~

One entanglement in the ground tackle of a commercial cod jigger fishery was reported to the NMFS Alaska Region in 2013 (Table 2; Helker et al. 2015). Since observer data are not available for this fishery, this mortality results in a mean annual mortality and serious injury rate of 0.2 humpback whales in 2009-2013 (Table 2) and, since the event occurred in the area where the two stocks overlap, the mortality is assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales.

The estimated mean annual mortality and serious injury rate incidental to U.S. commercial fisheries is ~~0.6~~0.8 ~~whales per year from this stock~~ (0.6 based on observed fisheries + 0.2 based on stranding data) Western North Pacific humpback whales per year;~~.~~ ~~H~~however, this estimate is considered a minimum because there are no data concerning fishery-related mortalit~~ies~~y and serious injury in Japanese, Russian, or international waters. ~~In addition, there is a small probability that fishery interactions discussed in the assessment for the Central North Pacific stock may have involved animals from this stock because of the overlap with the Central North Pacific stock.~~

~~Strandings~~Reports of swimming, floating, or beachcast humpback whales entangled in fishing gear or with injuries caused by interactions with gear, which may be from commercial, recreational, or subsistence fisheries, are another source of fishery-related mortality and serious injury data. However, very few stranding reports are received from areas west of Kodiak. The estimated mean annual ~~human-caused~~ mortality and serious injury rate ~~for 2008-2012 based on~~from fishery-related ~~and~~ gear entanglements and interactions reported to~~in~~ the NMFS Alaska Region~~al Office~~ stranding database in 2009-2013, in which ~~is 0.3 (Table 2). These~~ the events have not been attributed to a specific fishery listed on the MMPA List of Fisheries (76 FR 73912; 29 November 2011), is 0.4 humpbacks per year (Table 2). Since these events occurred in the area where the two stocks overlap, this mortality is assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales. These estimates are considered a minimum because not all entangled animals strand and not all stranded animals are found, reported, or have the cause of death determined. The estimated average annual mortality and serious injury rate due to interactions with all fisheries in 2009-2013 is ~~0.9~~1.2 (~~0.6~~0.8 in commercial fisheries + ~~0.3~~0.4 in unknown fisheries) Western North Pacific humpback whales.

Table 2. Summary of mortality and serious injury of ~~w~~Western North Pacific humpback whales~~ mortalities and serious injuries~~, by year and type, reported to the NMFS Alaska Region~~al Office,~~ marine mammal stranding database~~,~~ ~~for the 2008-2012 period~~in 2009-2013 (~~Allen et al. 2014,~~ Helker et al. 2015). Injury events lacking detailed injury information ~~on the injury~~ are assigned prorated values following injury determination guidelines described in NOAA (2012). All events occurred within the area of known overlap ~~with~~between the ~~w~~Western North Pacific and ~~c~~Central North Pacific humpback whale stocks. Since the stock identification is unknown, the mortality~~ies~~ and serious injury~~ies (M/SI) are~~ is reflected in both ~~s~~Stock ~~a~~Assessment Reports. A summary of information used to determine whether an injury was serious or non-serious, as well as a table of prorate values used for large whale reports with incomplete information, is reported in Helker et al. (2015).

Cause of ~~I~~injury	~~2008~~	2009	2010	2011	2012	2013	Mean ~~A~~annual ~~M~~mortality
~~Entangled in unknown gillnet gear~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Entangled in recreational shrimp pot gear~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Entangled in unspecified crab gear~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Entangled in unspecified longline gear~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
Entangled in commercial cod jigger gear	~~0~~	0	0	0	0	1	0.2
Entangled in unspecified pot gear	~~0~~	0	0	0.75	0	0	~~0.15~~0.2
Entangled in unspecified set net gear	~~0~~	0	0	0.75	0	0	~~0.15~~0.2
Ship strike (charter)	~~0.52~~	0	0	0	0.2	0	~~0.14~~0.04
~~Ship strike (recreational)~~	~~0.56~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0.11~~ 0
~~Ship strike (research)~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
Ship strike (whale watch)	~~0~~	0	0	0	1	0	0.2
Entangled in ~~U~~unknown marine debris/gear~~ entanglement~~	~~0~~	0.75	0	2.5	0.75	0	0.8
~~Minimum total annual mortality~~							~~1.56~~

Brownell et al. (2000) compiled records of bycatch in Japanese and Korean commercial fisheries between 1993 and 2000. During the period 1995-1999, there were six humpback whales indicated as "bycatch." In addition, two strandings were reported during this period. Furthermore, analysis of four samples from meat found in markets indicated that humpback whales are being sold. At this time, it is not known whether any or all strandings were caused by incidental interactions with commercial fisheries; similarly, it is not known whether the humpback whales identified in market samples were killed as a result of incidental interactions with commercial fisheries. It is also not known which fishery may be responsible for the bycatch. Regardless, these data indicate a minimum mortality level of 1.1/year (using bycatch data only) to 2.4/year (using bycatch, stranding, and market data) in the waters of Japan and Korea. Because many mortalities pass unreported, the actual rate in these areas is likely much higher. An analysis of entanglement rates from photographs collected for SPLASH found a minimum entanglement rate of 31% for humpback whales from the Asia breeding grounds (Cascadia Research NFWF Report #2003-0170-019).

Alaska Native Subsistence/~~Native~~ Harvest Information

There are no reported takes of humpback whales from this stock by Native subsistence hunters in Alaska or Russia ~~for the 2008-2012 period~~in 2009-2013.

Other ~~m~~Mortality

Other sources of human-caused mortality and serious injury include ~~reported collisions with vessels~~ship strikes and entanglement in unknown marine debris/gear. The ~~mean~~ minimum mean annual ~~human-caused~~ mortality and serious injury rate of 1 Western North Pacific humpback whale per year ~~for 2008-2012~~in 2009-2013 is based on ~~vessel collisions~~ship strikes (~~0.45~~0.2) and entanglement in unknown marine debris/gear (0.8) reported ~~in~~to the NMFS Alaska Region~~al Office~~ stranding database ~~is 1.25~~ (Table 2). Since these events occurred in the area where the stocks overlap, this mortality is assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales.

HISTORICAL WHALING

Rice (1978) estimated that the number of humpback whales in the North Pacific may have been approximately 15,000 individuals prior to exploitation; however, this was based upon incomplete data and, given the level of known catches (legal and illegal) since World War II, may be an underestimate. Intensive commercial whaling removed more than 28,000 animals from the North Pacific during the 20th century (Rice 1978). A total of 3,277 reported catches occurred in Asia between 1910 and 1964, with 817 catches from Ogasawara between 1924 and 1944 (Nishiwaki 1966, Rice 1978). After World War II, substantial catches occurred in Asia near Okinawa (including 970 between 1958 and 1961), as well as around the main islands of Japan and the Ogasawara Islands. On the feeding grounds, substantial catches occurred around the Commander Islands and western Aleutian Islands, as well as in the Gulf of Anadyr (Springer et al. 2006).

Humpback whales in the North Pacific were theoretically fully protected in 1965, but illegal catches by the U.S.S.R. continued until 1972 (Ivashchenko et al. 2007). From 1961 to 1971, 6,793 humpback whales were killed illegally by the U.S.S.R. Many animals during this period were taken from the Gulf of Alaska and Bering Sea (Doroshenko 2000); however, additional illegal catches were made across the North Pacific, from the Kuril Islands to the Queen Charlotte Islands, and other takes in earlier years may have gone unrecorded.

STATUS OF STOCK

NMFS recently concluded a global humpback whale ~~s~~Status ~~r~~Review (Bettridge et al. 2015)~~, the report of which is being finalized~~. ~~NMFS will include the relevant results of this review in the SARs when they are available.~~ The estimated mean annual human-~~related~~caused ~~annual~~ mortality and serious injury rate of 2.2 (~~0.9~~1.2 from fishery-related interactions + ~~1.25~~1 from other interactions ~~= 2.15~~) Western North Pacific humpback whales is less than the calculated ~~conservative~~ PBR level for this stock (~~3.0~~2.9). The minimum estimate~~d~~ of the mean annual ~~human~~U.S. commercial fishery-related mortality and serious injury rate for this stock (0.8) ~~based solely on mortalities that occurred incidental to U.S. commercial fisheries is 0.6; therefore, the estimated fishery mortality and serious injury rate~~ exceeds 10% of the PBR (~~0.3~~0.29) and cannot be considered insignificant and approaching zero. In addition, there is a lack of information about fisheries bycatch from Russia, Japan, Korea, and international waters, as well as earlier evidence of bycatch in Japan and Korea (1.1 to 2.4 whales per year based on bycatch, stranding, and market data~~;~~: Brownell et al. 2000). The humpback whale is listed as "endangered" under the Endangered Species Act~~,~~ and, therefore, designated as "depleted" under the MMPA. As a result, the Western North Pacific stock of humpback whale is classified as a strategic stock. The status of this stock relative to its Optimum Sustainable Population ~~size~~ is currently unknown.

HABITAT CONCERNS

Elevated levels of sound from anthropogenic sources (e.g., shipping, military sonars) are a potential concern for humpback whales in the North Pacific, but no specific habitat concerns have been identified for this stock. Other potential impacts include possible changes in prey distribution with climate change, ~~increased fishing~~entanglement in fishing gear, ~~and~~ ship strikes due to increased vessel traffic (e.g., from increased shipping in higher latitudes and through the Bering Sea with changes in sea-ice coverage), as well as oil and gas activities in the Chukchi and Beaufort seas.

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Revised ~~10/09/2014~~9/8/2015

HUMPBACK WHALE (*Megaptera novaeangliae*):
Central North Pacific Stock

NOTE – ~~February 2014~~July 2015: The status and population structure of humpback whales in the North Pacific and elsewhere is currently under review by NMFS as part of a global Status Review of the species. ~~Changes to existing management units are being considered as part of this process, notably following analysis of genetic data from the SPLASH project (Baker et al. 2013); however, until the Status Review is published it is inappropriate to change the existing stock designations described here, including for the western North Pacific and central North Pacific populations.~~

STOCK DEFINITION AND GEOGRAPHIC RANGE

The humpback whale is distributed worldwide in all ocean basins. In winter, most humpback whales occur in the subtropical and tropical waters of the Northern and Southern Hemispheres. Humpback whales in the high latitudes of the North Pacific are seasonal migrants that feed on euphausiids and small schooling fishes (Nemoto 1957, 1959; Clapham and Mead 1999). The humpback whale population was considerably reduced as a result of intensive commercial exploitation during the 20th century.

A large-scale study of humpback whales throughout the North Pacific was conducted in 2004-2006 (the Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) project). Initial results from this project (Calambokidis et al. 2008, Barlow et al. 2011), including abundance estimates and movement information, have been reported in Baker et al. (2008, 2013)~~,~~ and are also summarized in Fleming and Jackson (2011); however, these results are still being considered for stock structure analysis.

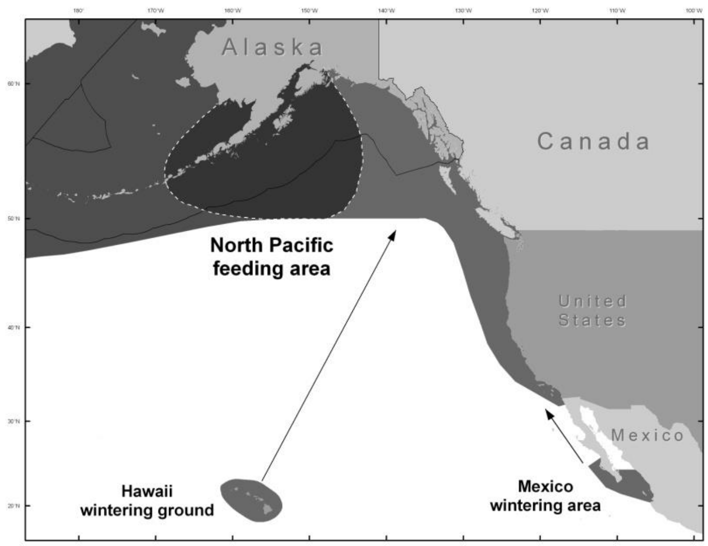

Figure 1. Approximate distribution of humpback whales in the eastern North Pacific (dark shaded areas). Feeding and wintering areas are presented above (see text). Area within the dotted line is known to be an area ~~of overlap with~~where the Central North Pacific and Western North Pacific stocks overlap. See Figure 1 in the Western North Pacific humpback whale ~~SAR~~Stock Assessment Report for distribution of humpback whales in the western North Pacific.

The historic summer feeding range of humpback whales in the North Pacific encompassed coastal and inland waters around the Pacific Rim from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk and north of the Bering Strait (Zenkovich 1954, Nemoto 1957, Tomlin 1967, Johnson and Wolman 1984). Historically, the Asian wintering area extended from the South China Sea east through the Philippines, Ryukyu Retto, Ogasawara Gunto, Mariana Islands, and Marshall Islands (Rice 1998). Humpback whales are currently found throughout this historic range. Most of the current winter range of humpback whales in the North Pacific is relatively well known, with aggregations of whales in Japan, the Philippines, Hawaii, Mexico, and Central America. The winter range includes the main islands of the Hawaiian archipelago, with the greatest concentration along the west side of Maui. In Mexico, the winter breeding range includes waters around the southern part of the Baja California peninsula, the central portions of the Pacific coast of mainland Mexico, and the Revillagigedos Islands off the mainland coast. The winter range also extends from southern Mexico into Central America, including Guatemala, El Salvador, Nicaragua, and Costa Rica (Calambokidis et al. 2008).

Photo-identification data, distribution information, and genetic analyses have indicated that in the North Pacific there are at least three breeding populations (Asia, Hawaii, and Mexico/Central America) that all migrate between their respective winter/spring calving and mating areas and their summer/fall feeding areas (Calambokidis et al. 1997, Baker et al. 1998). Calambokidis et al. (2001) further suggested that there may be as many as six subpopulations on the wintering grounds. From photo-identification and Discovery tag mark information there are known connections between Asia and Russia, between Hawaii and Alaska, and between Mexico/Central America and California (Darling 1991, Darling and Cerchio 1993, Calambokidis et al. 1997, Baker et al. 1998~~, Darling 1991, Darling and Cerchio 1993~~). This information led to the designation of three stocks of humpback whales in the North Pacific: 1) the California/Oregon/Washington and Mexico stock, consisting of winter/spring populations in coastal Central America and coastal Mexico which migrate to the coast of California to southern British Columbia in summer/fall (Calambokidis et al. 1989, Steiger et al. 1991, Calambokidis et al. 1993); 2) the ~~c~~Central North Pacific stock, consisting of winter/spring populations of the Hawaiian Islands which migrate primarily to northern British Columbia/Southeast Alaska, the Gulf of Alaska, and the Bering Sea/Aleutian Islands (Baker et al. 1990, Perry et al. 1990, Calambokidis et al. 1997); and 3) the ~~w~~Western North Pacific stock, consisting of winter/spring populations off Asia which migrate primarily to Russia and the Bering Sea/Aleutian Islands.

Information from the SPLASH project mostly confirms this view of humpback whale distribution and movements in the North Pacific. For example, the SPLASH results confirm low rates of interchange between the three principal wintering regions (Asia, Hawaii, and Mexico). However, the full SPLASH results suggest the current view of population structure is incomplete. The overall pattern of movements is complex but indicates a high degree of population structure. Whales from wintering areas at the extremes of their range on both sides of the Pacific migrate to coastal feeding areas that are on the same side of the Pacific: whales from Asia in the west migrate to Russia and whales from mainland Mexico and Central America in the east migrate to coastal waters off California~~-~~/Oregon.

The SPLASH data now show the Revillagigedos whales are seen in all sampled feeding areas except ~~N~~northern California~~-~~/Oregon and the south side of the Aleutians, and are primarily distributed in the Bering Sea, Gulf of Alaska, and Southeast Alaska/northern British Columbia, but are also found in Russia and southern British Columbia/Washington. The migratory destinations of humpback whales from Hawaii were found to be quite similar, and a significant number of matches (14) were seen during SPLASH between Hawaii and the Revillagigedos (Calambokidis et al. 2008). This suggests a need for some modification to the current view of winter/breeding populations. After a Status Review under the Endangered Species Act, NMFS has proposed designating four Distinct Population Segments (DPS) of humpback whales in the North Pacific: Western North Pacific, Hawaii, Mexico, and Central America (https://www.federalregister.gov/articles/2015/04/21/2015-09010/endangered-and-threatened-species-humpback-whale-megaptera-novaeangliae-identification-of-14). If this proposed rule results in the designation of DPSs in the North Pacific, ~~A~~a parallel revision of MMPA population structure in the North Pacific will be considered~~ when the full genetic results from the SPLASH project are available~~.

The winter distribution of the ~~c~~Central North Pacific stock is primarily in the Hawaiian archipelago. In the SPLASH study, sampling occurred on Kauai, Oahu, Penguin Bank (off the southwest tip of the island of Molokai), Maui, and the island of Hawaii (the Big Island). Interchange within Hawaii was extensive. Although most of the Hawaii identifications came from the Maui sub-area, identifications from the Big Island and Kauai at the eastern and western end of the region showed a high rate of interchange with Maui.

A relevant finding from the SPLASH project is that whales from the Aleutian Islands, and perhaps also the Gulf of Anadyr in Russia and the Bering Sea, have an unusually low re-sighting rate in winter areas compared to whales from other feeding areas. ~~To a lesser extent this is also true of whales from the Gulf of Anadyr in Russia and the Bering Sea.~~ One explanation for this result could be that some of these whales have a winter migratory destination that was not sampled during the SPLASH project. Given the location of these feeding areas, the most parsimonious explanation would be that some of these whales winter somewhere between Hawaii and Asia, which would include the possibility of the Marianas Islands (southwest of the Ogasawara Islands), the Marshall Islands (approximately half-way between the Marianas and Hawaiian Islands), and the Northwestern Hawaiian Islands. Indeed, humpback whales have been found to occur in the Northwestern Hawaiian Islands, though apparently at relatively low density (Johnston et al. 2007)~~.~~, but n~~N~~o other areas with high densities of humpback whales are known between the Hawaiian main islands and Ogasawara~~, but this could be due to a lack of search effort~~. Which stock that whales found in these locations would belong to is currently unknown.

In summer, the majority of whales from the ~~c~~Central North Pacific stock are found in the Aleutian Islands, Bering Sea, Gulf of Alaska, and Southeast Alaska/northern British Columbia. High densities of humpback whales are found in the eastern Aleutian Islands, particularly along the north side of Unalaska Island, and along the Bering Sea shelf edge and break to the north towards the Pribilof Islands. Small numbers of humpback whales are known from a few locations not sampled during the SPLASH study, including northern Bristol Bay and the Chukchi and Beaufort Seas. In the Gulf of Alaska, high densities of humpback whales are found in the Shumagin Islands, south and east of Kodiak Island, and from the Barren Islands through Prince William Sound. Although densities in any particular location are not high, humpback whales are also found in deep waters south of the continental shelf from the eastern Aleutians through the Gulf of Alaska. Relatively high densities of humpback whales occur throughout much of Southeast Alaska and northern British Columbia.

POPULATION SIZE

Prior to the SPLASH study, the most complete estimate of abundance for humpback whales in the North Pacific was from data collected in 1991-1993, with a best mark-recapture estimate of 6,010 (CV = 0.08) for the entire North Pacific, using a winter-to-winter comparison (Calambokidis et al. 1997). Estimates for Hawaii and Mexico were higher using marks from summer feeding areas with recaptures on the winter grounds, and totaled almost 10,000 summed across all winter areas. In the SPLASH study, fluke photographs were collected by over 400 researchers in all known feeding areas from Russia to California and in all known wintering areas from Okinawa and the Philippines to the coast of Central America and Mexico during 2004-2006. Over 18,000 fluke identification photographs were collected, and these have been used to estimate the abundance of humpback whales in the entire North Pacific Basin. Based on a comparison of all winter identifications to all summer identifications, the Chapman-Petersen estimate of abundance is 21,808 (CV=0.04) (Barlow et al. 2011). A simulation study identifies significant biases in this estimate from violations of the closed population assumption (+5.3%), exclusion of calves (-10.3%), failure to achieve random geographic sampling (+1.5%), and missed matches (+9.8%) (Barlow et al. 2011). Sex-biased sampling favoring males in wintering areas does not add significant bias if both sexes are proportionately sampled in the feeding areas. The bias-corrected estimate is 20,800 after accounting for a net positive bias of 4.8%. This estimate is likely to be lower than the true abundance due to two additional sources of bias: individual heterogeneity in the probability of being sampled (un-quantified) and the likely existence of an unknown and un-sampled wintering area (-7.2%).

The ~~c~~Central North Pacific stock of humpback whales winters in Hawaiian waters (Baker et al. 1986). ~~Baker et al. (1987) used capture-recapture methods in Hawaii to estimate the population at 1,407 (95% CI: 1,113-1,701), which they considered an estimate for the entire stock for 1980-1983. Mobley et al. (2001) conducted aerial surveys throughout the main Hawaiian Islands during 1993, 1995, 1998, and 2000. Abundance during these line-transect surveys was estimated as 2,754 (95% CI: 2,044-3,468), 3,776 (95% CI: 2,925-4627), 4,358 (95% CI: 3,261-5,454), and 4,491 (95% CI: 3,146-5,836). Before the SPLASH study, the best estimate of abundance for Hawaii from photo-identification data was 4,005 (CV = 0.10) for the years 1991-1993 (Calambokidis et al. 1997). Initial~~ Preliminary mark-recapture abundance estimates ~~have been calculated~~ from the SPLASH data were calculated in Calambokidis et al. (2008), using a multistrata Hilborn model. ~~Point estimates of abundance for Hawaii ranged from 7,469 to 10,103; the estimate from the best model~~ The best estimate for Hawaii (as chosen by AICc) was 10,103~~.~~; no ~~C~~confidence limit~~s~~ or CV~~s have not yet been~~ was calculated for ~~the~~that ~~SPLASH abundance~~ estimate~~s~~. Wade et al. (in review) have recalculated abundance estimates for winter areas from the SPLASH data using a similar multistrata model. The best estimate for Hawaii (as chosen by AICc) was 10,252 (CV = 0.042). This represents the best available abundance estimate for Hawaii.

In the SPLASH study, the number of unique identifications in different regions included 63 in the Aleutian Islands (defined as everything on the south side of the islands), 491 in the Bering Sea, 301 in the western Gulf of Alaska (including the Shumagin Islands), and 1,038 in the northern Gulf of Alaska (including Kodiak and Prince William Sound), with a few whales seen in more than one area (Calambokidis et al. 2008). The same multistrata model used to estimate abundance for winter areas was also used to estimate abundance in summer areas (Wade et al. in review). The ~~SPLASH abundance~~combined estimate~~s ranged from 6,000 to 19,000 combined~~ for the Aleutian Islands, Bering Sea, and Gulf of Alaska was ~9,800, a considerable increase from previous estimates that were available (e.g., Waite et al. 1999, Moore et al. 2002, Witteveen et al. 2004, Zerbini et al. 2006). However, the SPLASH surveys ~~were more extensive in scope, including~~covered areas not covered in those previous surveys, such as parts of Russian waters (Gulf of Anadyr and Commander Islands), the western and central Aleutian Islands, offshore waters in the Gulf of Alaska and Aleutian Islands, and Prince William Sound. Additionally, mark-recapture estimates can be higher than line-transect estimates because they estimate the total number of whales that have used the study area during the study period, whereas, line-transect surveys provide a snapshot of average abundance in the survey area at the time of the survey. For the Aleutian Islands and Bering Sea (including the Commander Islands and Gulf of Anadyr in Russia), the SPLASH estimate~~s ranged from 2,889 to 13,594.~~ was 7,914 (CV = 0.101) (Wade et al. in review); f~~F~~or the Gulf of Alaska (from Prince William Sound to the Shumigan Islands, including Kodiak Island), the SPLASH estimate~~s ranged from 2,845 to 5,122~~ was 1,906 (CV = 0.086) (Wade et al. in review). Given known overlap in the distribution of the ~~w~~Western and ~~c~~Central North Pacific humpback whale stocks, estimates for these feeding areas may include whales from the ~~w~~Western North Pacific stock, but those would be a very small percentage of all the whales (Wade et al. in review).

The SPLASH study showed a relatively high rate of interchange between Southeast Alaska and northern British Columbia, so they are considered together. Humpback whale studies have been conducted since the late 1960s in Southeast Alaska. Baker et al. (1992) estimated an abundance of 547 (95% CI: 504-590) using data collected from 1979 to 1986. Straley (1994) recalculated the estimate using a different analytical approach (Jolly-Seber open model for capture-recapture data) and obtained a mean population estimate of 393 animals (95% CI: 331-455) using the same 1979 to 1986 data set. Using data from 1986 to 1992 and the Jolly-Seber approach, Straley et al. (1995) estimated that the annual abundance of humpback whales in Southeast Alaska was 404 animals (95% CI: 350-458). Straley et al. (2009) examined data for the northern portion of southeast Alaska from 1994 to 2000 and provided an updated abundance estimate of 961 (CV=0.12). In the northern British Columbia region (primarily near Langara Island), 275 humpback whales were photo-identified from 1992 to 1998 (G. Ellis, Pacific Biological Station, pers. comm.). As of 2003, approximately 850-1,000 humpback whales had been identified in British Columbia (J. Ford, Department of Fisheries and Oceans, Canada, pers. comm.). During the SPLASH study, 1,115 unique identifications were made in Southeast Alaska and 583 in northern British Columbia, for a total of 1,669 individual whales, after subtracting whales seen in both areas (1,115+583-13-16 = 1,669) (Calambokidis et al. 2008). From the SPLASH study, the estimate~~s~~ of abundance for Southeast Alaska/northern British Columbia ~~ranged from 2,883 to 6,414~~is 5,046 (CV = 0.048) (Wade et al. in review). The estimates from SPLASH are considerably larger than the estimate from Straley et al. (2009). This is because the SPLASH estimates included areas not part of the Straley et al. (2009) estimate, including southern Southeast Alaska, northern British Columbia, and offshore waters of both British Columbia and Southeast Alaska.

Minimum Population Estimate

A total of 2,367 unique individuals were seen in the Hawaiian wintering areas during the 2-year period (3 winter field seasons) of the SPLASH study. As discussed above, ~~point~~the best estimate~~s~~ of abundance for Hawaii from SPLASH ~~ranged from 7,469 to 10,103~~is 10,252 (CV = 0.042) (Wade et al. in review)~~; the estimate from the best model was 10,103, but no associated CV has yet been calculated. The 1991-1993 abundance estimate for Hawaii using similar (but less) data had a CV of 0.095. Therefore, it is unlikely the CV of the SPLASH estimate, once calculated, would be greater than 0.300~~. The minimum population estimate (N_{MIN}) for this stock is calculated according to Equation 1 from the potential biological removal (PBR) ~~G~~guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate (N) of ~~10,103~~10,252 from the best fit model and ~~an assumed conservative~~ CV(N) of ~~0.30~~ 0.042 results in an N_{MIN} for the central North Pacific humpback whale stock of ~~7,890~~9,896.

Although the Southeast Alaska/northern British Columbia feeding aggregation is not formally considered a stock, the calculation of what a PBR would be for this area is useful for management purposes. The total number of unique individuals seen during the SPLASH study was 1,669 (1,115 in southeast Alaska). ~~The abundance estimate of Straley et al. (2009) had a CV of 0.12, and the SPLASH abundance estimates are unlikely to have a much higher CV. Using the lowest population estimate (N) of 2,883 and an assumed worst case CV(N) of 0.30,~~The SPLASH estimate of abundance is 5,046 (CV = 0.048), which results in an N_{MIN} for this aggregation ~~is 2,251~~of 4,846. ~~Similarly, f~~For the Aleutian Islands and Bering Sea, ~~using~~ the ~~lowest~~ SPLASH estimate of ~~2,889~~7,914 (CV = 0.101) ~~with an assumed worst-case CV of 0.30~~ results in an N_{MIN} of ~~2,256~~7,270. For the Gulf of Alaska (from Prince William Sound to the Shumigan Islands, including Kodiak Island), ~~using~~ the ~~lowest~~ SPLASH estimate of ~~2,845~~ 1,906 (CV = 0.086) ~~with an assumed worst-case CV of 0.30~~ results in an N_{MIN} of ~~2,222~~1,773. Estimates for these feeding areas may include whales from the ~~w~~Western North Pacific stock and the Mexican breeding population.

Current Population Trend

Comparison of the estimate for the entire stock provided by Calambokidis et al. (1997) with the 1981 estimate of 1,407 (95% CI: 1,113-1,701) from Baker et al. (1987) suggests that abundance increased in Hawaii between the early 1980s and early 1990s. Mobley et al. (2001) estimated a trend of 7% per year for 1993-2000 using data from aerial surveys that were conducted in a consistent manner for several years across all of the Hawaiian Islands and were developed specifically to estimate a trend for the ~~c~~Central North Pacific stock. Mizroch et al. (2004) estimated survival rates for North Pacific humpback whales using mark-recapture methods, and a model fit to data from Hawaii for the years 1980-1996 resulted in an estimated rate of increase of 10% per year (95% C~~.I.~~: ~~of~~ 3-16%). For shelf waters of the northern Gulf of Alaska, Zerbini et al. (200~~7~~6) estimated an annual rate of increase for humpback whales from 1987 to 2003 of 6.6% per year (95% CI: 5.2-8.6%). The SPLASH abundance estimate for the total North Pacific represents an annual increase of 4.9% over the most complete estimate for the North Pacific from 1991 to 1993. Comparisons of SPLASH abundance estimates for Hawaii to estimates from 1991 to 1993 gave estimates of annual increase that ranged from 5.5 to 6.0% (Calambokidis et al. 2008). No confidence limits were calculated for these rates of increase from SPLASH data. It is also clear that the abundance has increased in Southeast Alaska, though a trend for the Southeast Alaska portion of this stock cannot be estimated from the data because of differences in methods and areas covered.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Using a birth-interval model, Barlow and Clapham (1997) have estimated a population growth rate of 6.5% (SE = 1.2%) for the well-studied humpback whale population in the Gulf of Maine, although there are indications that this rate has slowed over the last decade (Clapham et al. 2003). Estimated rates of increase for the Central North Pacific stock include values for Hawaii of 7.0% (from aerial surveys), 5.5-6.0% (from mark-recapture abundance estimates), and 10% (95% CI: 3-16%) (from a model fit to mark-recapture data), and for the northern Gulf of Alaska a value of 6.6% (95% CI: 5.2-8.6%) (from ship surveys) (Calambokidis et al. 2008). Although there is no estimate of the maximum net productivity rate for the Central North Pacific stock, it is reasonable to assume that R_{MAX} for this stock would be at least 7%. Hence, until additional data become available from the Central North Pacific humpback whale stock, it is recommended that 7% be employed as the maximum net productivity rate (R_{MAX}) for this stock.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the ~~potential biological removal (~~PBR~~)~~ is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The default recovery factor (F_R) for this stock is 0.1, the recommended value for cetacean stocks listed as endangered under the Endangered Species Act (Wade and Angliss 1997). A recovery factor of ~~0.3~~0.5 is used in calculating the PBR based on the suggested guidelines of Taylor et al. (2003), based on an increasing population that has an N_{MIN} greater than 5,000. The default value of 0.04 for the maximum net productivity rate is replaced by 0.07, which is the best estimate of the current rate of increase and is considered a conservative estimate of the maximum net productivity rate. For the Central North Pacific stock of humpback whale, using the SPLASH study abundance estimate from the best fit model for 2004-2006 for Hawaii of ~~10,103~~ 10,252 with a~~n assumed~~ CV of ~~0.300~~ 0.042 and its associated N_{MIN} of ~~7,890~~ 9,896, PBR is calculated to be ~~82.8~~173.2 animals (~~7,890~~ 9,896 x 0.035 x ~~0.3~~ 0.5).

At this time, stock structure of humpback whales is under consideration and revisions may be proposed within the next few years. One possibility would be to revise stock structure to be consistent with summer feeding aggregations, as has been done for the North Atlantic population of humpback whales. If this were to occur, possible groupings could be~~:~~ Southeast Alaska/northern British Columbia, Gulf of Alaska, and Aleutian Islands/Bering Sea. Just for information purposes, PBR calculations are completed here for these feeding area aggregations.~~For Southeast Alaska and northern British Columbia, the smallest abundance estimates from the SPLASH study were used with an assumed worst-case CV of 0.3 to calculate PBRs for feeding areas.~~ Using the suggested guidelines presented in Taylor et al. (2003), it would be appropriate to use a recovery factor of 0.3 ~~only~~ for the Southeast Alaska/northern British Columbia feeding aggregation since this aggregation has an N_{MIN} greater than 1,500 and less than 5,000 and has an increasing population trend. A recovery factor of ~~0.1~~0.4 is appropriate for the Aleutian Islands and Bering Sea feeding aggregation as the N_{MIN} is greater than 5,000 and the trend is unknown. A recovery factor of 0.3 is appropriate for ~~and~~ the Gulf of Alaska feeding aggregation because the N_{MIN} is greater than 1,500 and less than 5,000 and ~~based on~~ has an ~~unknown~~increasing population trend. ~~For~~If we calculated a PBR for the Southeast Alaska/northern British Columbia feeding aggregation it would be ~~PBR is calculated to be 23.6~~ 50.9 (~~2,251~~4,846 x 0.035 x 0.3). If we calculated a PBR ~~F~~for the Aleutian Islands and Bering Sea, ~~PBR is calculated to~~it would be ~~7.9~~101.8 (~~2,256~~7,270 x 0.035 x ~~0.1~~0.4). If we calculated a PBR f~~F~~or the Gulf of Alaska, ~~PBR is calculated to~~it would be ~~7.8~~18.6 (~~2,222~~1,773 x 0.035 x ~~0.1~~0.3). However, note that the actual PBR for the Central North Pacific stock is 173.2 based on the breeding population size in Hawaii, as calculated above.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~New Serious Injury Guidelines~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations~~

~~for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Until 2004, there were four different federally-regulated commercial fisheries in Alaska that occurred within the range of the ~~c~~Central North Pacific humpback whale stock that were monitored for incidental mortality and serious injury by fishery observers. As of 2004, changes in fishery definitions in the MMPA List of Fisheries have resulted in separating these ~~four~~4 fisheries into 17 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort~~,~~ but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska. Between ~~2008 and 2012~~2009 and 2013, there was one known incidental serious injury and mortality of a ~~central North Pacific~~ humpback whale in the Bering Sea/Aleutian Islands flatfish trawl fishery and two in the Bering Sea/Aleutian Islands pollock trawl fishery~~;~~ (Table 1). Since the stock identification of these whales is unknown, and the events occurred within the area where the Central North Pacific and Western North Pacific stocks are known to overlap, the mortality in these fisheries is assigned to both stocks of humpback whales. ~~o~~One Central North Pacific humpback whale injured in the Hawaii shallow set longline fishery in 2011 is prorated at 0.75 under the injury determination guidelines for large whales, since the severity of ~~the~~its injury ~~in~~is unknown (Table 1).

In 2012 and 2013, the Alaska Marine Mammal Observer Program (AMMOP) placed observers on independent vessels in the state-managed Southeast Alaska salmon drift gillnet fishery to assess mortality and serious injury of marine mammals. Areas around and adjacent to Wrangell and Zarembo Islands (ADF&G Districts 6, 7, and 8) were observed during the 2012-2013 program (Manly 2015). In 2013, one humpback whale was seriously injured. Based on the one observed serious injury, 11 serious injuries were estimated for Districts 6, 7, and 8 in 2013, resulting in an estimated mean annual mortality and serious injury rate of 5.5 Central North Pacific humpback whales in 2012-2013 (Table 1). Since these three districts represent only a portion of the overall fishing effort in this fishery, we expect this to be a minimum estimate of mortality for the fishery.

Humpback whale mortality and serious injury due to entanglement in the Southeast Alaska salmon drift gillnet fishery was reported to the NMFS Alaska Region in 2012 (1 whale) and 2013 (1.75 whales) (Helker et al. 2015); however, this mortality and serious injury is accounted for by the AMMOP observer data for this fishery (in Table 1). One entanglement in the ground tackle of a commercial cod jigger fishery was also reported to the NMFS Alaska Region in 2013 (Table 2; Helker et al. 2015). Since observer data are not available for this fishery, this mortality results in a mean annual mortality and serious injury rate of 0.2 humpback whales in 2009-2013 (Table 2) and, since the event occurred in the area where the two stocks overlap, the mortality is assigned to both the Central North Pacific and Western North Pacific stocks of humpback whales. Reports to the NMFS Pacific Islands Region stranding database in 2008-2012 result in an additional mean annual mortality and serious injury rate of 0.8 Central North Pacific humpback whales per year due to entanglement in commercial fisheries gear: 0.2 each in the Alaska king crab pot, Alaska tanner crab pot, Alaska shrimp pot, and Hawaii crab pot fisheries (Table 3; Bradford and Lyman 2015).

The minimum estimate of the mean annual mortality and serious injury rate incidental to U.S. commercial fisheries for the entire Central North Pacific stock is 7.3 humpback whales per year, based on observer data from Alaska (0.6 in the federal groundfish fisheries + 5.5 in the state-managed Southeast Alaska salmon drift gillnet fishery: Table 1) and Hawaii (0.2: Table 1) and on reports, in which the commercial fishery is confirmed, to the NMFS Alaska Region stranding database (0.2: Table 2) and the NMFS Pacific Islands Region stranding database (0.8: Table 3).

Table 1. Summary of ~~observer reported~~ incidental mortality~~ies~~ and serious injury~~ies~~ of the Central North Pacific stock of humpback whales ~~(Central North Pacific stock)~~ due to observed U.S. commercial fisheries from ~~2008 to 2012~~2009 to 2013 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; Bradford and Forney 2014; Manly 2015; NMFS, unpubl. data; NMML, unpubl. data). ~~Details of how~~Methods for calculating percent observer coverage ~~is measured~~ are ~~included~~described in Appendix 6 of the Alaska Stock Assessment Reports. N/A indicates that data are not available.

Fishery name	Years	Data type	Percent ~~O~~observer coverage	Observed mortality~~/~~ ~~serious injury (in given yrs.)~~	Estimated mortality~~/~~ ~~serious injury (in given yrs.)~~	Mean estimated annual mortality~~/~~ ~~serious injury~~
Bering Sea/Aleutian Is. flatfish trawl[~~1~~a]	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~100~~ ~~100~~99% ~~100~~99% ~~100~~99% ~~100~~99% 99%	~~0~~ 0 0 (+1)[~~*~~b] 0 0 0	~~0~~ 0 0 (+1)[~~**~~c] 0 0 0	0.2~~0~~ (CV = N/A)
Bering Sea/Aleutian Is. pollock trawl[~~1~~a]	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~85~~ 86% 86% 98% 98% 97%	~~0~~ 0 1 0 1 0	~~0~~ 0 1.0 0 1.0 0	0.4 (CV = ~~0.08~~ 0.68)~~***~~
SE AK salmon drift gillnet (Districts 6, 7, 8)	2012 2013		6.4% 6.6%	0 1	0 11	5.5 (CV = 1.0)
HI shallow set longline	~~2008~~ 2009 2010 2011 2012 2013	obs data	~~100~~ 100% 100% 100% 100% 100%	~~0~~ 0 0 1[~~2~~d] 0 0	~~0~~ 0 0 0.75[~~2~~d] 0 0	~~0.15~~0.2
Minimum total estimated annual mortality					North: SE: HI: Total:	0.6 ~~0.0~~5.5 ~~0.15~~0.2 ~~0.75~~6.3 (CV = 0.88)

[~~1~~a]Mortality and serious injury in this fishery is assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales, since the stock identification is unknown and the two stocks overlap within the area of operation of the fishery.
[~~*~~b]Total mortality~~ies~~ and serious injury observed in 2010: 0 in sampled hauls + 1 in an unsampled hauls.
[~~**~~c]~~Total mortalities observed in sampled and unsampled hauls.~~ Since the total known mortality and serious injury (0 observed in monitored hauls + 1 in an unmonitored haul) exceeds the estimated mortality and serious injury (0) for the fishery in 2010, the ~~sum of actual mortalities~~ observed mortality and serious injury (~~1~~in sampled + unsampled hauls) will be used as a minimum estimate for that year.
~~***CV does not accommodate the 2012 data.~~
~~[1]Mortality and serious injury in this fisheryis assigned to both the Western North Pacific and Central North Pacific stocks of humpback whales, since the stock identification is unknown and the two stocks overlap within the area of operation of the fishery.~~
[~~2~~d]A humpback was entangled and cut free with trailing gear ~~trailing~~. Due to the unknown configuration of the entanglement, this injury is being prorated with a value of 0.75 (Bradford and Forney 2014).

Reports of swimming, floating, or beachcast ~~entangled~~ humpback whales ~~found swimming, floating, or stranded~~entangled ~~with~~in fishing gear ~~attached~~or with injuries caused by interactions with gear, which may be from commercial, recreational, or subsistence fisheries, ~~occur in both Alaskan and Hawaiian waters~~are another source of information on fishery-related mortality and serious injury. ~~All reports of Alaska mortalities or injuries of humpback whales from the central North Pacific stock from 2008 to 2012 are summarized in Allen et al. (2014) and Helker et al. (2015) along with details regarding injury determination and assessment. A summary of the information is provided in Tables 2 and 3.~~ Based on events that have not been attributed to a specific fishery listed on the MMPA List of Fisheries (76 FR 73912; 29 November 2011), ~~T~~the estimated mean annual ~~human-caused~~ mortality and serious injury rate ~~for 2008-2012 based on~~from fishery-related ~~and~~ gear entanglements is 7 humpback whales per year: 2.9 reported ~~in~~to the NMFS Alaska Regional~~ Office~~ stranding database in 2009-2013 ~~is 2.85: 0.2 in the commercial Southeast Alaska salmon drift gillnet fishery and 2.65 that has not been attributed to a specific fishery listed on the List of Fisheries (76 FR 73912; 29 November 2011)~~ (Table 2; Helker et al. 2105). ~~The estimated annual mortality and serious injury for~~ and 4.1 reported to the NMFS Pacific Islands Region stranding database in 2008-2012 ~~due to entanglements reported in waters off Hawaii is 4.8~~ (Table 3; Bradford and Lyman 2015). These estimates are considered a minimum because not all entangled animals strand and not all stranded animals are found, reported, or cause of death determined.

The minimum average annual estimate of mortality and serious injury rate due to all fisheries is 14 (7.3 from commercial fisheries + 7 from unknown fisheries) Central North Pacific humpbacks per year.

Table 2. Summary of mortality and serious injury of ~~opportunistic reports of c~~Central North Pacific humpback 2whales ~~mortalities and serious injuries caused by entanglement (marine debris, commercial and recreational fisheries) as well as vessel collisions~~ reported to the NMFS Alaska Regional~~ Office,~~ marine mammal stranding database~~, for the 2008-2012 period~~ in 2009-2013 (~~Allen et al. 2014,~~ Helker et al. 2015). Injury events lacking detailed information on the injury are assigned prorated values following injury determination guidelines described in NOAA (2012). A summary of information used to determine whether an injury was serious or non-serious, as well as a table of prorate values used for large whale reports with incomplete information, is reported in ~~Allen et al. (2014)~~Helker et al. (2015).

Cause of ~~I~~injury	~~**2008**~~	**2009**	**2010**	**2011**	**2012**	**2013**	**Mean ~~A~~annual ~~M~~mortality**
~~Entangled in SE AK salmon drift gillnet~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~		~~0.2~~
Entangled in commercial cod jigger gear	~~0~~	0	0	0	0	1	0.2
Entangled in unknown gillnet gear	~~0~~	0.75	3	0.75	1.75	0	~~1.25~~1.3
Entangled in recreational shrimp pot gear	~~0~~	1.75	0	0	0	0	~~0.35~~0.4
Entangled in unspecified crab gear	~~0~~	0	0	0.75	0	0	~~0.15~~0.2
Entangled in unspecified longline gear	~~0~~	0	0	0.75	0.75	0	0.3
Entangled in unspecified pot gear	~~0~~	0	1.5	0.75	0	0	~~0.45~~0.5
Entangled in unspecified set net gear	~~0~~	0	0	0.75	0	0	~~0.15~~0.2
Ship strike (charter)	~~0.72~~	0.76	0	0	0.2	0	~~0.34~~0.2
Ship strike (pilot vessel)	~~0~~	0	0	0	0.2	0	0.04
~~Ship strike (recreational)~~	~~0.76~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0.15~~ 0
~~Ship strike (research)~~	~~0.2~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0.04~~ 0
Ship strike (unknown)	~~0.4~~	0.36	4	2	1.2	0.14	~~1.59~~1.5
Ship strike (whale watch)	~~0~~	0	0	0	1	0	0.2
Unknown marine debris/gear entanglement	~~3~~	2.25	2.25	5.5	0.75	2.25	~~2.75~~2.6
~~Minimum total annual mortality~~							~~7.96~~

Table 3. Summary of mortality and serious injury of Central North Pacific humpback whales~~Data on opportunistically reported entanglements and vessel collisions occurring in Hawaii waters are~~ reported to the NMFS Pacific Islands Region stranding database in 2008-2012 (~~in~~ Bradford and Lyman ~~(~~2015).

Cause of ~~I~~injury	**2008**	**2009**	**2010**	**2011**	**2012**	**Mean ~~A~~annual ~~M~~mortality**
Entangled in commercial AK king crab pot gear	0	0	0	0.75	0	~~0.15~~0.2
Entangled in commercial AK tanner crab pot gear	0	0	0	0	1	0.2
Entangled in commercial AK shrimp pot gear	0	1	0	0	0	0.2
Entangled in commercial HI crab pot gear	0	0.75	0	0	0	~~0.15~~0.2
Entangled in recreational troll gear	0	0	0	1.5	0	0.3
Entangled in unknown fishing gear	1.75	4.75	5	3.25	4.25	3.8
~~Vessel Collision~~Ship strike	5.04	1.4	2.0	1.72	1.72	~~2.38~~2.4
~~Minimum total annual mortality~~						~~7.18~~

~~The overall U.S. commercial fishery-related minimum mortality and serious injury rate for the entire stock is 1.65 humpback whales per year, based on observer data from Alaska (0.6), opportunistic stranding and human interaction reports from Alaska in which the commercial fishery is confirmed (0.20), observer data from Hawaii (0.15), and opportunistic stranding and human interaction reports from Hawaii in which the commercial fishery is confirmed (0.7). Additional fisheries-related (may include commercial, recreational, or subsistence fisheries reports) mortality and serious injury rates based on stranding records from Alaska (2.65) and stranding records from Hawaii (4.1) result in an overall minimum estimate of mortality and serious injury rate due to fisheries of 8.4 (1.65 + 2.65 + 4.1).~~

~~As mentioned previously~~However, these estimates of serious injury and ~~/~~mortality levels should be considered a minimum. No observers have been assigned to several fisheries that are known to interact with this stock, making the estimated mortality and serious injury rate unreliable. Further, due to limited Canadian observer program data, mortality and serious injury incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries known to interact with humpback whales) is uncertain. Though interactions are thought to be minimal, data regarding the level of humpback whale mortality and serious injury related to commercial fisheries in northern British Columbia are not available, again indicating that the estimated mortality and serious injury incidental to commercial fisheries is underestimated for this stock.

Alaska Native Subsistence/~~Native~~ Harvest Information

Subsistence hunters in Alaska are not authorized to take from this stock of humpback whales, and no takes have been reported.

Other Mortality

Ship strikes and other interactions with vessels unrelated to fisheries ~~have also~~ occur~~red~~ frequently ~~to~~with humpback whales (Tables 2 and 3). Neilson et al. (2012) summarized 108 large whale ship-strike events in Alaska from 1978 to 2011, 25 of which are known to have resulted in the whale's death. Eighty-six percent of these reports involved humpback whales. The mean annual ~~human-caused~~ mortality and serious injury rate ~~for 2008-2012~~ due to ~~vessel collisions~~ship strikes reported in Alaska in 2009-2013 (~~2.36~~1.9: Table 2) and Hawaii in 2008-2012 (~~2.38~~2.4: Table 3) is ~~4.74~~4.3 humpback whales~~(Tables 2 and 3)~~. Most ~~vessel collisions with~~ship strikes of humpbacks are reported from Southeast Alaska; however, there are also reports from the south-central and Kodiak areas of Alaska (~~Allen et al. 2014,~~ Helker et al. 2015). Many of the ship strikes~~vessel collisions~~ occurring off Hawaii are reported from waters near Maui (Bradford and Lyman 2015). It is not known whether the difference in ship-~~-~~strike rates between Southeast Alaska and the northern portion of this stock is due to differences in reporting, amount of vessel traffic, densities of animals, or other factors. Entanglements in unknown marine debris/gear reported to the NMFS Alaska Region account for an estimated average annual mortality and serious injury rate of ~~2.75~~2.6 Central North Pacific humpbacks ~~annually~~in 2009-2013 (Table 2).

HISTORICAL WHALING

Rice (1978) estimated that the number of humpback whales in the North Pacific may have been approximately 15,000 individuals prior to exploitation; however, this was based upon incomplete data and, given the level of known catches (legal and illegal) since World War II, may be an underestimate. Intensive commercial whaling removed more than 28,000 animals from the North Pacific during the 20th century. Humpback whales in the North Pacific were theoretically protected in 1965, but illegal catches by the U.S.S.R. continued until 1972 (Ivashchenko et al. 2007). From 1961 to 1971, 6,793 humpback whales were killed illegally by the U.S.S.R. Many animals during this period were taken from the Gulf of Alaska and Bering Sea (Doroshenko 2000); however, additional illegal catches were made across the North Pacific, from the Kuril Islands to the Queen Charlotte Islands, and other takes in earlier years may have gone unrecorded.

On the feeding grounds of the ~~c~~Central North Pacific stock after World War II the highest density of catches occurred around the western Aleutian Islands, in the eastern Aleutian Islands (and adjacent Bering Sea to the north and Pacific Ocean to the south), and British Columbia (Springer et al. 2006). Lower but still relatively high density of catches occurred south of the Commander Islands, along the south side of the Alaska Peninsula and around Kodiak Island.

Lower densities of catches also occurred in the Gulf of Anadyr, in the central Aleutian Islands, in much of the offshore Gulf of Alaska, and in Southeast Alaska.

No catches were reported in the winter grounds of the ~~c~~Central North Pacific stock in Hawaii, nor in Mexican winter areas.

STATUS OF STOCK

NMFS recently concluded a global humpback whale ~~s~~Status ~~r~~Review (Bettridge et al. 2015)~~, the report of which is being finalized~~. ~~NMFS will include the relevant results of this review in the SARs when they are available.~~ Although the estimated mean annual human-caused mortality and serious injury rate for the entire Central North Pacific stock ~~(15.89; 1.65 of which were commercial fishery-related)~~ (21) is considered a minimum, it is unlikely that the total level of human-caused mortality and serious injury exceeds the PBR level (~~82.8~~173) for the entire stock. The minimum estimate~~d~~ of the mean annual U.S. commercial fishery-related mortality and serious injury rate for this stock (~~1.65~~7.3) ~~for this stock~~ is less than 10% of the calculated PBR for the entire stock (~~8.3~~17) and, therefore, can be considered to be insignificant and approaching a zero mortality and serious injury rate. The humpback whale is listed as "endangered" under the Endangered Species Act~~,~~ and, therefore, designated as "depleted" under the MMPA. As a result, the central North Pacific stock of humpback whale is classified as a strategic stock. However, the status of the entire stock relative to its Optimum Sustainable Population ~~size~~ is unknown.

HABITAT CONCERNS

This stock is the focus of a large whale-~~-~~watching industry in its wintering grounds (Hawaii) and a growing whale-~~-~~watching industry in its summering grounds (Alaska). Regulations concerning minimum distance to keep from whales and how to operate vessels when in the vicinity of whales have been developed for Hawaii and Alaska waters in an attempt to minimize the impact of whale watching. Additional concerns have been raised in Hawaii about the impact of jet skis and similar fast waterborne tourist-related traffic, notably in nearshore areas inhabited by mothers and calves. In ~~2001~~Alaska, NMFS issued regulations in 2001 to prohibit ~~most~~ approaches to humpback whales ~~in Alaska~~ within 100 yards (91.4 m; 66 FR 29502; 31 May 2001). The growth of the whale-~~-~~watching industry, however, is an ongoing concern as preferred habitats may be abandoned if disturbance levels are too high. Other potential concerns include elevated levels of sound from anthropogenic sources (e.g., shipping, military sonars), possible changes in prey distribution with climate change, entanglement in fishing gear, ship strikes due to increased vessel traffic (e.g., from increased shipping in higher latitudes), and oil and gas activities.

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FIN WHALE (*Balaenoptera physalus*): Northeast Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the U.S. waters in the Pacific, fin whales are found seasonally off the coast of North America and in the Bering Sea during the summer (Fig. 1). Recent information on seasonal fin whale distribution has been gleaned from the reception of fin whale calls by bottom-mounted, offshore hydrophone arrays along the U.S. Pacific coast, in the central North Pacific, and in the western Aleutian Islands (Moore et al. 1998, 2006; Watkins et al. 2000; Stafford et al. 2007; Širovic et al. 2013; Soule and Wilcock 2013). Moore et al. (1998, 2006), Watkins et al. (2000), and Stafford et al. (2007) documented high ~~levels~~rates of fin whale calling ~~rates~~ along the U.S. Pacific coast beginning in August/September and lasting through February, suggesting that these may be important feeding areas during the winter. Širovic et al. (2013) speculated that both resident and migratory fin whales may occur off Southern California based on shifts in peaks in fin whale calling data. Soule and Wilcock (2013) documented fin whale call rates in a presumed feeding area along the Juan de Fuca Ridge, offshore of northern Washington State, and found that some whales appear to head northwest from August to October. They speculate that some fin whales may migrate northward in fall and southward in winter. While peaks in call rates occurred during late summer, fall, and winter in the central North Pacific and the Aleutian Islands, fin whale calls were seldom detected during summer months even though fin whales are regularly seen in summer months in the Gulf of Alaska (Stafford et al. 2007). ~~In addition, f~~Fin whale calls were detected in the southeast Bering Sea using an instrument moored there from April 2006 through April 2007, which showed peaks in fin whale call detections from September through November 2006 and also in February and March 2007 (Stafford et al. 2010). In addition, fin whale calls were detected in the northeastern Chukchi Sea using instruments moored there in July through October from 2007 through 2010 (Delarue et al. 2013). Call data collected from the Bering Sea suggest that several fin whale stocks may feed in the Bering Sea, but call data collected in the northeast Chukchi Sea suggest that only one of the putative Bering Sea stocks appears to migrate that far north to feed (Delarue et al. 2013). ~~While seasonal differences in recorded call rates are in some cases consistent with the results of aerial surveys which have documented seasonal whale distribution, it is not known whether these differences in call rates reflect true seasonal differences in whale distribution, differences in calling rates, or differences in oceanographic properties (Moore et al. 1998).~~ Some fin whale calls have also been recorded in the Hawaiian ~~waters~~Exclusive Economic Zone in all months except June and July (Thompson and Friedl 1982, McDonald and Fox 1999). Sightings of fin whales in Hawaii are extremely rare: ~~T~~there was a sighting in 1976 (Shallenberger 1981), a sighting ~~by Dale Rice~~ in 1979 (Mizroch et al. 2009), a sighting during an aerial survey in 1994 (Mobley et al. 1996), and ~~5~~five sightings during a survey in 2002 (Barlow 2006).

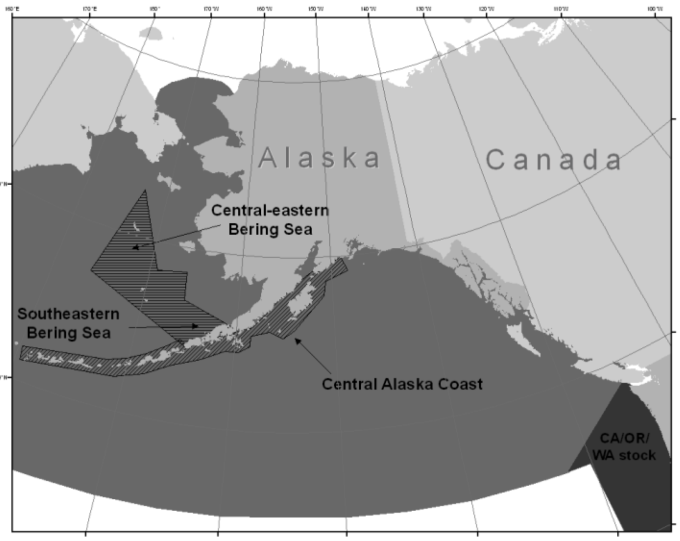

Figure 1. Approximate distribution of fin whales in the eastern North Pacific (dark shaded areas). Striped areas indicate where vessel surveys occurred in 1999-2000 (Moore et al. 2002) and 2001-2003 (Zerbini et al. 2006).

Surveys on the Bering Sea shelf in 1997, 1999, 2000, 2002, 2004, 2008, and 2010 and in coastal waters of the Aleutian Islands and the Alaska Peninsula from 2001 to 2003 provided information about the distribution and relative abundance of fin whales in these areas (Moore et al. 2000, 2002; Zerbini et al. 2006; Friday et al. 2012, 2013). Fin whales were the most common large whale sighted during the Bering Sea shelf surveys in all years except for 1997 and 2004 (Friday et al. 2012, 2013). Fin whales were consistently distributed both in the “~~‘~~green belt,”~~’,~~ an area of high productivity along the edge of the EBS continental shelf (Springer et al. 1996), and in the middle shelf with the highest abundances occurring in the “~~‘~~green belt.”~~’.~~ Abundance estimates for fin whales in the Bering Sea were consistently higher in cold years than in warm years (Friday et al. 2012, 2013) indicating a shift in distribution. This is consistent with a fine-scale comparison of fin whale occurrence on the middle shelf between a cold year (1999) and a warm year (2002), which found that the group and individual encounter rates were 7-12 times higher in the cold year (Stabeno et al. 2012).

~~Fin whales were seen regularly by whaling vessels in the Chukchi Sea in the 1920s-1940s and were taken by whalers at least until the early 1950s. After this time, despite some continued effort to hunt other species, many fewer fin whales were seen through at least until the late 1970s but not thereafter (Nemoto 1959, Sleptsov 1961).~~Based on historical whaling data, fin whales were found to range into the southern Sea of Okhotsk and Chukchi Sea. It was assumed that they passed through the Bering Strait into the southwestern Chukchi Sea during August and September. Many were taken as far west as Mys (Cape) Shmidta (68°55'N, 179°24'E) and as far north as 69°04'N, 171°06'W (Mizroch et al. 2009). Fin whales are again being seen increasingly during sighting surveys in the Chukchi Sea in summer (Funk et al. 2010, Aerts et al. 2012, Clarke et al. 2013) and have been recorded each year from 2007 to 2010 in August and September on bottom-mounted hydrophones in the Chukchi Sea (Delarue et al. 2013), suggesting they may be re-occupying habitat used prior to large-scale commercial whaling.

The following information was considered in classifying stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous in winter, possibly isolated in summer; 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this limited information, the International Whaling Commission considers fin whales in the North Pacific to all belong to the same stock (Mizroch et al. 1984), although those authors cited additional evidence that supported the establishment of subpopulations in the North Pacific. Further, Fujino (1960) described eastern and western groups, which are isolated though may intermingle around the Aleutian Islands. Discovery mark recoveries (Rice 1974, Mizroch et al. 2009) indicate that animals wintering off the coast of southern California range from central California to the Gulf of Alaska during the summer months.

Mizroch et al. (2009) provided a comprehensive summary of whaling catch data, Discovery mark recoveries, and opportunistic sightings data and found evidence that suggests there may be at least ~~6~~six populations of fin whales: ~~2~~two that are migratory (eastern and western North Pacific) and ~~2 to 4~~2-4 more that are resident year-round in peripheral seas such as the Gulf of California, East China Sea, Sanriku-Hokkaido, and possibly in the Sea of Japan. It appears likely that the two migratory stocks mingle in the Bering Sea in July and August, rather than in the Aleutian Islands as Fujino (1960) concluded (Mizroch et al. 2009). During winter months, fin whales have been seen over a wide geographic area from 23°N to 60°N, but winter distribution and location of primary wintering areas (if any) are poorly known and need further study. As a result, stock structure of fin whales remains uncertain.

For management purposes, three stocks of fin whales are currently recognized in U.S. Pacific waters: 1) Alaska (Northeast Pacific), 2) California/Washington/Oregon, and 3) Hawaii. Mizroch et al. (2009) suggest that this structure should be reviewed and updated, if appropriate, to reflect recent analyses, but the absence of any substantially new data on stock structure makes this difficult. The California/Oregon/Washington and Hawaii fin whale stocks are reported separately in the Stock Assessment Reports for the Pacific Region.

POPULATION SIZE

Reliable estimates of current and historical abundance for the entire Northeast Pacific fin whale stock are currently not available. Two studies provide some information on the distribution and occurrence of fin whales, although they do not provide estimates of population size. A survey conducted in August of 1994 covering 2,050 nautical miles of trackline south of the Aleutian Islands encountered only four fin whale groups (Forney and Brownell 1996). However, this survey did not include all of the waters off Alaska where fin whale sightings have been reported, thus~~,~~ no population estimate ~~can~~could be made.

Visual shipboard surveys for cetaceans were conducted on the eastern Bering Sea shelf during summer in 1997, 1999, 2000, 2002, 2004, 2008, and 2010 (Moore et al. 2000, 2002; Friday et al. 2012, 2013). These surveys were conducted in conjunction with the Alaska Fisheries Science Center echo-integrated trawl survey for walleye pollock which determined the survey area and timing. The surveys included from 789 km to 3,752 km of effort depending on the year and whether the entire area was surveyed for cetaceans. Results of the surveys in 2002, 2008, and 2010, years when the entire pollock area was surveyed, provided provisional estimates of 419 (CV = 0.33), 1,368 (CV = 0.34), and 1,061 (CV = 0.38)~~, respectively~~fin whales (Friday et al. 2013). These estimates are considered provisional because they have not been corrected for animals missed on the trackline, animals submerged when the ship passed, and responsive movement. However, they are expected to be robust as previous studies have shown that only small correction factors are needed for this species (Barlow 1995). This estimate cannot be used as an estimate of the entire Northeast Pacific stock of fin whales because it is based on a survey in only part of the stock's range.

Dedicated line-transect cruises were conducted in coastal waters (as far as 85 km offshore) of western Alaska and the eastern and central Aleutian Islands in July-August 2001-2003 (Zerbini et al. 2006). Over 9,053 km of tracklines were surveyed ~~in coastal waters (as far as 85 km offshore)~~ between the Kenai Peninsula (150°W) and Amchitka Pass (178°W). Fin whale sightings (n = 276) were observed from east of Kodiak Island to Samalga Pass, with high aggregations recorded near the Semidi Islands. Zerbini et al. (2006) estimated that 1,652 (95% CI: 1,142-2,389) fin whales occurred in the area.

Minimum Population Estimate

Although the full range of the ~~n~~Northeast Pacific stock of fin whales in Alaskan waters has not been surveyed, a rough estimate of the size of the population west of the Kenai Peninsula has been calculated in previous ~~SARs~~Stock Assessment Reports by summing the estimates from Moore et al. (2002) and Zerbini et al. (2006) (n = 5,700). However, ~~new information indicates that~~based on analyses presented in Mizroch et al. (2009), whales surveyed in the Aleutians (Zerbini et al. 2006) could migrate into the Bering Sea and be counted during the Bering Sea surveys ~~(Mizroch et al. 2009)~~. There are also indications that fin whale distribution in the Bering Sea is related to oceanographic conditions (Stabeno et al. 2012, Friday et al. 2013), making it possible that whales could be double counted when estimates from different years are summed (Moore et al. 2002). Therefore, our best provisional estimate of the fin whale population west of the Kenai Peninsula would be 1,368, the greater of the minimum estimates from the 2008 and 2010 surveys (Friday et al. 2013). This is a minimum estimate for the entire stock because it was estimated from surveys which covered only a small portion of the range of this stock. This is considered a minimum estimate for a portion of the range of this stock; therefore, the N_{MIN} for the entire stock is unknown.

Current Population Trend

Zerbini et al. (2006) estimated rates of increase of fin whales in coastal waters south of the Alaska Peninsula (Kodiak and Shumagin Islands). An annual increase of 4.8% (95% CI: 4.1-5.4%) was estimated for the period 1987-2003. This estimate is the first available for North Pacific fin whales and is consistent with other estimates of population growth rates of large whales. It should be used with caution, however, due to uncertainties in the initial population estimate for the first trend year (1987) and due to uncertainties about the population structure of the fin whales in the area. Also, the study represented only a small fraction of the range of the ~~n~~Northeast Pacific stock.

Friday et al. (2013) estimated a 14% (95% CI: 1.0-26.5%) annual rate of change in abundance of fin whales ~~between~~during the period from 2002 ~~and~~to 2010. However, this apparent rate of change in abundance is higher than most plausible estimates of rates of change for large whale populations (see Zerbini et al. 2010 for a discussion of maximum rates of increase for humpback whale populations). It is likely that the apparent rate of change in abundance in the study area is due at least in part to changes in distribution and not just to changes in overall population size. Friday et al. (2013) found that the abundance of fin whales in the survey area increased in colder years, likely due to shifts in the distribution of prey. Stafford et al. (2010) provided evidence of prey-driven distribution where fin and right whale call rates in the vicinity of mooring M2 (approximate location: 57.9°N, 164.1°W) increased following peaks in euphausiid and copepod biomass.

Moore and Barlow (2011) analyzed trends in fin whale abundance from 1991 to 2008 from surveys conducted off California and found sufficient variability in trend estimates to conclude that the estimates were likely demonstrating dispersal of new individuals into the study area rather than actual population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Zerbini et al. (2006) estimated an annual increase in coastal waters south of the Alaska Peninsula of 4.8% (95% CI: 4.1-5.4%) for the period 1987-2003. However, there are uncertainties in the initial population estimate from 1987, as well as uncertainties regarding fin whale population structure in this area. A reliable estimate of the maximum net productivity rate is currently unavailable for the Northeast Pacific fin whale stock. Hence, until additional data become available, it is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the recommended value for cetacean stocks which are listed as endangered (Wade and Angliss 1997). However, because an estimate of minimum abundance is not available, the PBR level for the ~~Alaska~~Northeast Pacific fin whale stock is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~New Serious Injury Guidelines~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

~~Between 2008 and 2012, there was o~~One ~~observed~~ incidental mortality of a fin whale ~~in~~ due to entanglement in the ground tackle of a commercial mechanical jig fishing vessel was reported to the NMFS Alaska Region in 2012 (Table 1; Helker et al. 2015~~; Table 1~~). Since observer data are not available for this fishery, this mortality results in a mean annual mortality and serious injury rate of 0.2 fin whales in 2009-2013 (Table 1).

Table 1. Summary of mortality and serious injury of the Northeast Pacific stock of fin whales ~~mortalities and serious injuries~~, by year and type, reported to the Alaska Region~~al Office~~, marine mammal stranding database, ~~for the 2008-2012 period~~in 2009-2013 (~~Allen et al. 2014,~~ Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of ~~I~~injury	~~2008~~	2009	2010	2011	2012	2013	Mean ~~A~~annual ~~M~~mortality
Ship strike	~~0~~	1	1	0	0	0	0.4
Entangled in ground tackle of commercial mechanical jig fishing vessel	~~0~~	0	0	0	1	0	0.2
~~Minimum total annual mortality~~							~~0.60~~

Alaska Native Subsistence/~~Native~~ Harvest Information

Subsistence hunters in Alaska and Russia have not been reported to take fin whales from this stock.

Other Mortality

Between 1911 and 1985, 49,936 fin whales were reported killed throughout the North Pacific (Mizroch et al. 2009), although newly revealed information about illegal Soviet catches indicates that the Soviets over-reported catches of about 1,200 fin whales, presumably to hide catches of other protected species (Doroshenko 2000). ~~Two~~ Fin whale mortality due to ship-strikes ~~mortalities of fin whales occurred~~ in Alaska waters ~~between 2008 and 2012~~ (one each in 2009 and ~~one in~~ 2010) ~~and have~~has also been reported ~~in~~ to the NMFS Alaska Region stranding database (~~Allen et al. 2014~~Helker et al. 2015), resulting in a mean annual mortality and serious injury rate of 0.4 fin whales due to ship strikes in 2009-2013 (Table 1).

STATUS OF STOCK

The fin whale is listed as "endangered" under the Endangered Species Act of 1973, and therefore designated as "depleted" under the MMPA. As a result, the Northeast Pacific stock is classified as a strategic stock. While reliable estimates of the minimum population size and population trends are available for a portion of this stock, much of the North Pacific range has not been surveyed. Therefore the status of the stock relative to its

Optimum Sustainable Population ~~size~~ is currently not available. The total estimated annual rate of mortality and serious injury for this stock is 0.6 based on takes incidental to U.S. commercial fisheries (0.2) and ship strikes (0.4). Because the PBR is ~~unknown~~undetermined, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown.

HABITAT CONCERNS

Potential impacts on fin whale habitat include possible changes in prey distribution with climate change, range extension, and increased shipping in higher latitudes with changes in sea ice coverage, as well as oil and gas activities in the Chukchi and Beaufort ~~s~~Seas.

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MINKE WHALE (*Balaenoptera acutorostrata*): Alaska Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

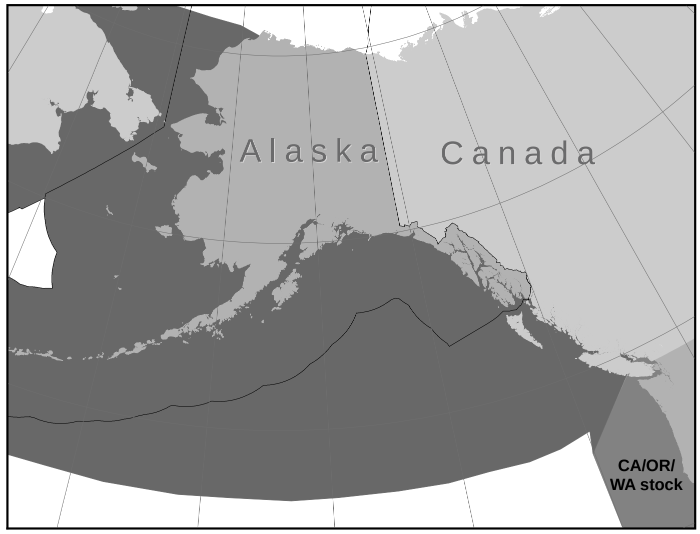

Figure 1. Approximate distribution of minke whales in the eastern North Pacific (dark shaded areas).

In the North Pacific, minke whales occur from the Bering and Chukchi Seas south to near the Equator (Leatherwood et al. 1982). The following information was considered in classifying stock structure according to the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution continuous;~~,~~ 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: unknown. Based on this limited information, in 1991 the International Whaling Commission (IWC) recognized three stocks of minke whales in the North Pacific: one in the Sea of Japan/East China Sea, one in the rest of the western Pacific west of 180°N, and one in the “remainder” of the Pacific (Donovan 1991). The “remainder” stock designation reflects the lack of exploitation in the eastern Pacific and does not indicate that only one population exists in this area (Donovan 1991). In the “remainder” area, minke whales are relatively common in the Bering and Chukchi Seas and in the inshore waters of the Gulf of Alaska (~~Mizroch 1992~~Moore et al 2000, Friday et al. 2012, Clarke et al. 2013)~~,~~ but are not considered abundant in any other part of the eastern Pacific (Leatherwood et al. 1982, Brueggeman et al. 1990). ~~Minke whales are known to penetrate loose ice during the summer, and some individuals venture north of the Bering Strait (Leatherwood et al. 1982).~~Recent visual and acoustic data found minke whales in the Chukchi Sea north of Bering Strait in July and August (Clarke et al. 2013), and minke whale “boing” sounds have been detected in the northeast Chukchi Sea in August, October, and November (Delarue 2013). There are two types of geographically distinct “boing” sounds produced by minke whales in the North Pacific (Rankin and Barlow 2005). Those recorded in the Chukchi Sea matched “central Pacific” boings leading the authors to hypothesize that minke whales from the Chukchi Sea might winter in the central North Pacific, not near Hawaii (Delarue et al. 2013).

Ship surveys ~~in the central-eastern and southeastern~~on the eastern Bering Sea shelf in 1999, ~~and~~ 2000, 2002, 2004, 2008, and 2010 resulted in new information about the distribution and relative abundance of minke whales in ~~these~~this area~~s~~ (Moore et al. ~~2000,~~ 2002; ~~see Fig. 1 in Northeast Pacific fin whale SAR for location of survey areas~~Friday et al. 2012, 2013). When comparing distribution and abundance in years when the entire study area was surveyed (2002, 2008, and 2010), Friday et al. (2013) found that minke whales were scattered throughout the study area in all oceanographic domains (coastal, middle shelf, and outer shelf/slope) in 2002 and 2008 but were concentrated in the outer shelf and slope in 2010. The highest minke whale abundance in the study area occurred in 2010 and abundance was greater in cold years (2008 and 2010) than a warm year (2002); however, changes in abundance were thought to be due at least in part to changes in distribution (Friday et al. 2013). ~~Minke whale abundance estimates were similar in the central-eastern Bering Sea and the southeastern Bering Sea (Moore et al. 2002). Minke whales occurred throughout the area surveyed, but most sightings of minke whales in the central-eastern Bering Sea occurred along the upper slope in waters 100-200 m deep (Moore et al. 2000); sightings in the southeastern Bering Sea occurred along the north side of the Alaska Peninsula and were associated with the 100 m contour near the Pribilof Islands (Moore et al. 2002).~~

So few minke whales were seen during two offshore Gulf of Alaska surveys for cetaceans in 2009 and 2013 that a population estimate for this species in this area could not be determined (Rone et al. 2010, 2014).

In the northern part of their range, minke whales are believed to be migratory, whereas, they appear to establish home ranges in the inland waters of Washington and along central California (Dorsey et al. 1990). Because the “resident” minke whales from California to Washington appear behaviorally distinct from migratory whales farther north, minke whales in Alaska are considered a separate stock from minke whales in California, Oregon, and Washington (Dorsey et al. 1990). Accordingly, two stocks of minke whales are recognized in U.S. waters: 1) Alaska, and 2) California/Washington/Oregon (Fig. 1). The California/Oregon/Washington minke whale stock is reported separately in the Stock Assessment Reports for the U.S. Pacific Region.

POPULATION SIZE

No estimates have been made for the number of minke whales in the entire North Pacific. However, some information is ~~now~~ available on the numbers of minke whales in some areas of Alaska. ~~A v~~Visual surveys for cetaceans ~~was~~were conducted ~~in~~on the ~~central-~~eastern Bering Sea shelf in ~~July-August 1999, and in the southeastern Bering Sea in 2000~~2002, 2008, and 2010~~,~~ in cooperation with research on commercial fisheries (~~Moore et al. 2000; Moore et al. 2002; see Fig. 1 in Northeast Pacific fin whale SAR for locations of survey areas~~Friday et al. 2013). The surveys included ~~1,761 km and 2,194 km~~3,752 km, 3,253 km, and 1,638 km of effort in ~~1999 and 2000~~2002, 2008, and 2010, respectively. Results of the surveys in ~~1999 and 2000~~2002, 2008, and 2010 provide provisional abundance estimates of ~~810 (CV = 0.36) and 1,003 (CV = 0.26)~~389 (CV = 0.52), 517 (CV = 0.69), and 2,020 (CV = 0.73) minke whales ~~in~~on the ~~central-eastern and south~~eastern Bering Sea shelf, respectively (~~Moore et al. 2002~~Friday et al. 2013). These estimates are considered provisional because they have not been corrected for animals missed on the trackline, animals submerged when the ship passed, or responsive movement. Additionally, line-transect surveys were conducted in shelf and nearshore waters (within 30-45 nm of land) in 2001-2003 from the Kenai Fjords in the Gulf of Alaska to the central Aleutian Islands. Minke whale abundance was estimated to be 1,233 (CV = 0.34) for this area (Zerbini et al. 2006). This estimate has also not been corrected for animals missed on the trackline. The majority of the sightings were in the Aleutian Islands, rather than in the Gulf of Alaska, and in water shallower than 200 m. These estimates cannot be used as an estimate of the entire Alaska stock of minke whales because only a portion of the stock's range was surveyed.

Minimum Population

At this time, it is not possible to produce a reliable estimate of minimum abundance for this stock, as current estimates of abundance are not available.

Current Population Trend

There are no data on trends in minke whale abundance in Alaska waters.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the growth rate of minke whale populations in the North Pacific (Best 1993). Hence, until additional data become available, it is recommended that the cetacean maximum net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. Given the status of this stock is unknown, the appropriate recovery factor is 0.5 (Wade and Angliss 1997). However, because an estimate of minimum abundance is not available, the PBR for the Alaska minke whale stock is unknown at this time.

ANNUAL HUMAN-CAUSED MORTALITY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

Detailed information on U.S. commercial fisheries in Alaska waters (including observer programs, observer coverage, and observed incidental takes of marine mammals) is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Six different commercial fisheries operating in Alaska waters within the range of the Alaska minke whale stock were monitored for incidental take by NMFS observers during ~~2002-2006~~2009-2013: the Bering Sea/~~ (and~~ Aleutian Islands~~)~~ groundfish trawl, longline, and pot fisheries~~,~~ and the Gulf of Alaska groundfish trawl, longline, and pot fisheries.~~ In 1989, one minke whale mortality (extrapolated to 2 mortalities) was observed in the Bering Sea/Gulf of Alaska joint-venture groundfish trawl fishery, the predecessor to the current Alaska groundfish trawl fishery. The Bering Sea/Aleutian Islands groundfish trawl fishery incurred one mortality of a minke whale in 2000, which extrapolated to an estimated two minke whale mortalities for that year. The total estimated mortality and serious injury incurred by this stock as a result of interactions with U. S. commercial fisheries for 2006-2010 is 0.~~ However, no mortality or serious injury of minke whales occurred in observed U.S. commercial fisheries in 2009-2013.

Alaska Native Subsistence/~~Native~~ Harvest Information

No minke whales were ever taken by the modern shore-based whale fishery in the eastern North Pacific which lasted from 1905 to 1971 (Rice 1974). Subsistence takes of minke whales by Alaska Natives are rare~~,~~ but have been known to occur. Only seven minke whales are reported to~~the~~ have been taken for subsistence by Alaska Natives between 1930 and 1987 (C. Allison, International Whaling Commission, U~~nited~~ K~~ingdom~~, pers. comm.). The most recent reported catches (~~2~~two whales) in Alaska occurred in 1989 (Anonymous 1991), but reporting is likely incomplete. Based on this information, the average annual subsistence take ~~averaged~~was zero minke whales ~~during the 5-year period from 2006 to 2010~~in 2009-2013.

Other Mortality

From ~~2006-2010~~2009 to 2013, ~~six dead minke whales have been~~ no human-related mortality or serious injury of minke whales was reported to the NMFS Alaska Region ~~S~~stranding ~~Program~~database (~~NMFS Alaska Regional Office, unpublished data~~Helker et al. 2015).~~ Two of these mortalities occurred in 2007, one of which was determined to be the result of a vessel strike. Four of these incidents occurred in 2010. The total mean annual mortality due to human-related causes based on stranding data is 0.2 for this 5-year period.~~

STATUS OF STOCK

Minke whales are not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. The greatest uncertainty regarding the status of the Alaska minke whale stock has to do with the uncertainty pertaining to the stock structure of this species in the eastern North Pacific. Because minke whales are considered common in the waters off Alaska and because the number of human-related removals is currently thought to be minimal~~ (0.2)~~, this stock is presumed to not be a strategic stock. Reliable estimates of the minimum population size, population trends, PBR, and status of the stock relative to its Optimum Sustainable Population ~~OSP~~ are currently not available. Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality and serious injury that can be considered insignificant and approaching zero mortality and serious injury rate is unknown.

HABITAT CONCERNS

Potential concerns include elevated levels of sound from anthropogenic sources (e.g., shipping, military sonars), possible changes in prey distribution with climate change, entanglement in fishing gear, ship strikes due to increased vessel traffic (e.g., from increased shipping in higher latitudes), and oil and gas activities.

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NORTH PACIFIC RIGHT WHALE (*Eubalaena japonica*):
Eastern North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

A review of all 20th~~th~~ century sightings, catches, and strandings of North Pacific right whales was conducted by Brownell et al. (2001). Data from this review were subsequently combined with historical whaling records to map the known distribution of the species (Figure 1; Clapham et al. 2004, Shelden et al. 2005). Although whaling records initially indicated that right whales ranged across the entire North Pacific north of 35°N and occasionally as far south as 20°N (Scarff 1986, 1991; Fig. 1), recent analysis shows a pronounced longitudinally bimodal distribution (Josephson et al. 2008a). Before right whales in the North Pacific were heavily exploited by commercial whalers, concentrations were found in the Gulf of Alaska, eastern Aleutian Islands, south-central Bering Sea, Sea of Okhotsk, and Sea of Japan (Braham and Rice 1984). An analysis conducted on the North Pacific right whale fishery by Josephson et al. (2008b) showed that within the course of a decade (1840s), right whale abundance was severely depleted, particularly in the eastern portion of their range. Following large illegal catches (1962-1968) by the U.S.S.R. (Ivashchenko and Clapham 2012, Ivashchenko et al. 2013), only 82 sightings of right whales in the entire eastern North Pacific were reported from 1962 to 1999, with the majority of these occurring in the Bering Sea and adjacent areas of the Aleutian Islands (Brownell et al. 2001). Additional sightings have been reported as far south as central Baja California and as far east as Yakutat Bay and Vancouver Island in the eastern North Pacific, as far south as Hawaii in the central North Pacific, and as far north as the sub-Arctic waters of the Bering Sea and Sea of Okhotsk in the summer (Herman et al. 1980; Rowntree et al. 1980; Berzin and Doroshenko 1982; Salden and Mickelsen 1999; Brownell et al. 2001; J. Ford, ~~pers. comm.,~~ Department of Fisheries and Oceans, BC, Canada, pers. comm., 28 October 2013). However, most right whale sightings in the past 20 years have occurred in the southeastern Bering Sea, with a few ~~and~~ in the Gulf of Alaska, ~~particularly~~ near Kodiak, AK (Waite et al. 2003; Shelden et al. 2005; Wade et al. 2011a, 2011b).

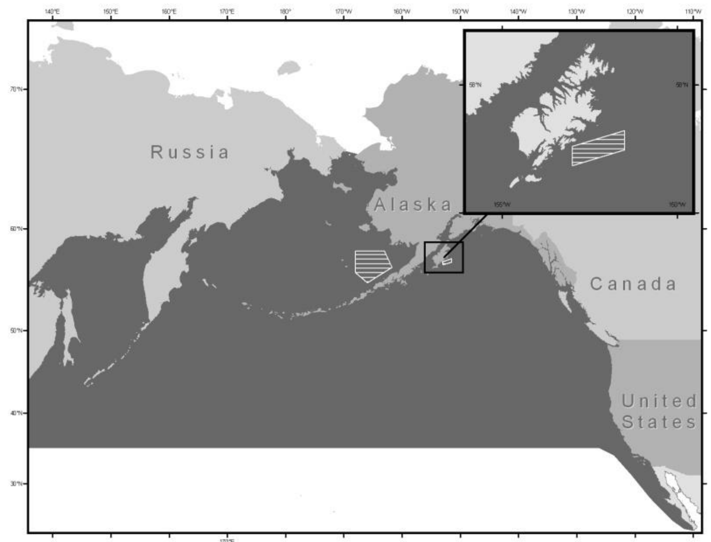

Figure 1. Approximate historical distribution of North Pacific right whales in the eastern North Pacific (dark shaded area). Striped areas indicate northern right whale critical habitat (71 FR 38277, 6 July 2006).

North Atlantic (*E. glacialis*) and Southern Hemisphere (*E. australis*) right whales calve in coastal waters during the winter months. However, in the eastern North Pacific no such calving grounds have been identified (Scarff 1986). Migratory patterns of North Pacific right whales are unknown, although it is thought they migrate from high-latitude feeding grounds in summer to more temperate waters during the winter, possibly well offshore (Braham and Rice 1984, Scarff 1986, Clapham et al. 2004). A right whale sighted off Maui in April 1996 was identified 119 days later and 4,111 km north in the Bering Sea (Salden and Michelsen 1999, Kennedy et al. 2011). While the photographic match confirms that Bering Sea animals occasionally travel south, there is currently no reason to believe that either Hawaii or tropical Mexico have ever been anything except extra-limital habitats for this species (Brownell et al. 2001).

Information on the summer and autumn distribution of right whales is available from dedicated vessel and aerial surveys, bottom-mounted acoustic recorders, and vessel surveys for fisheries ecology and management that have also included dedicated marine mammal observers. Aerial and vessel surveys for right whales have occurred in recent years in a portion of the southeastern Bering Sea (Fig. 1) where right whales have been observed most summers since 1996 (Goddard and Rugh 1998, Rone et al. 2012). North Pacific right whales are observed consistently in this area, although it is clear from historical and Japanese sighting survey data that right whales often range outside this area and occur elsewhere in the Bering Sea (~~Clapham et al. 2004; LeDuc et al. 2001;~~ Moore et al. 2000, 2002; LeDuc et al. 2001; Clapham et al. 2004). Bottom-mounted acoustic recorders were deployed in the southeastern Bering Sea and the northern Gulf of Alaska starting in 2000 to document the seasonal distribution of right whale calls (Mellinger et al. 2004). Analysis of the data from those recorders deployed between October 2000 and January 2006 indicates that right whales remain in the southeastern Bering Sea from May through December with peak call detection in September (Munger and Hildebrand 2004). Data from recorders deployed between May 2006 and April 2007 show the same trends (Stafford and Mellinger 2009, Stafford et al. 2010). Recorders deployed from 2007 to 2013 have not yet been fully analyzed, but they indicate the presence of right whales in the southeastern Bering Sea almost year-round, with a peak in August and a sharp decline in detections in early January (~~available~~ Catherine Berchok, NMFS, AFSC, ~~-~~NMML, 7600 Sand Point Way NE, Seattle, WA 98115~~;~~, unpubl.~~ished~~ data). Use of this habitat may intensify in mid-summer through early fall based on higher monthly and daily call detection rates. The probability of acoustically detecting right whales in the Bering Sea has been found to be strongly influenced by the abundance of the copepod *Calanus marshallae* (Baumgartner et al. 2013), and those authors propose that *C. marshallae* is the primary prey for right whales on the Bering Sea shelf. The seasonal development of these copepods into later life~~-~~–history stages that can be exploited by right whales closely matches the peak timing of right whale call detections (Munger et al. 2008, Baumgartner et al. 2013). Additionally, right whale "gunshot" call detections increased shortly after peaks in copepod biovolume (Stafford et al. 2010). Baumgartner et al. (2013) suggest that the availability of *C. marshallae* on the middle shelf of the southeast Bering Sea is the reason right whales aggregate there annually. Satellite telemetry data from four whales tagged in 2008 and 2009 provide further indication of this area's importance as foraging habitat for eastern North Pacific right whales (Zerbini et al. ~~in review~~2015). Right whales have not been observed outside the localized area in the southeastern Bering Sea during surveys conducted for fishery management purposes that covered a broader area of Bristol Bay and the Bering Sea (Moore et al. 2000, 2002; see Fig. 1 in the Northeast Pacific fin whale SAR for locations of tracklines for these surveys).

There are fewer recent sightings of right whales in the Gulf of Alaska than in the Bering Sea (Brownell et al. 2001), although little survey effort has been conducted in this region, notably in the offshore areas where right whales commonly occurred during whaling days (Ivashchenko and Clapham 2012). Waite et al. (2003) summarized sightings from the Platforms of Opportunity Program from 1959 to 1997. Additional lone animals were observed off Kodiak Island in the Barnabas Canyon area from NOAA surveys in August 2004, 2005, and 2006 (~~available~~ A. Zerbini, NMFS, AFSC,~~-~~ NMML, 7600 Sand Point Way NE, Seattle, WA 98115~~;~~, unpubl.~~ished~~ data). A single right whale was reported in Pasagshak Bay by a kayaker in May of 2010, and one was sighted in December 2011 by humpback researchers in Uganik Bay (A. Kennedy, NMFS, AFSC, ~~-~~NMML, pers. comm., 7 October 2012). A single right whale was sighted south of the Alaska Peninsula (53.5°N, 156.5°W) during a seismic survey in July 2011 (Davis et al. 2011). Acoustic monitoring from May 2000 to July 2001 at seven sites in the Gulf of Alaska detected right whale calls at only two sites: one off eastern Kodiak and the other in deep water south of the Alaska Peninsula (detection distance 10s of kilometers) (Mellinger et al. 2004). More recently, right whale up calls were detected on a recorder deployed near Quinn Seamount in the Gulf of Alaska on a few days each in June, July, August, and September 2013 (Sirovic et al. 2014).

Most of the illegal Soviet catches of right whales occurred in offshore areas, including a large area to the east and southeast of Kodiak (Doroshenko 2000, Ivashchenko and Clapham 2012); the Soviet catch distribution closely parallels that seen in plots of 19th~~th~~ century American whaling catches by Townsend (1935). Whether this region remains an important habitat for this species, or whether cultural memory of its existence has been lost, is currently unknown. The sightings and acoustic detection of right whales in coastal waters east of Kodiak indicates at least occasional continuing use of this area.

In recent years, there have been two sightings of single right whales in the waters of British Columbia. The first was observed off Haida Gwaii on 9 June 2013 and the second, a large adult, was seen in the Strait of Juan de Fuca on 25 October 2013; this second animal had an apparently healed major wound across the rostrum, which may have been caused by a previous entanglement in fishing gear (J. Ford, Department of Fisheries and Oceans, BC, Canada, pers. comm., 26 October 2013). Two right whale calls were detected on a bottom-mounted hydrophone off the Washington Coast on 29 June 2013. No right whale calls were detected in previous years at this site (Sirovic et al. 2014).

The following information was considered in classifying stock structure according to the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: distinct geographic distribution; 2) Population response data: unknown; 3) Phenotypic data: unknown; and 4) Genotypic data: evidence for some isolation of populations. Based on this limited information, two stocks of North Pacific right whales are currently recognized: a Western

North Pacific and an Eastern North Pacific stock (Rosenbaum et al. 2000, Brownell et al. 2001, LeDuc et al. 2012). The former is believed to feed primarily in the Sea of Okhotsk.

POPULATION SIZE

Illegal catches of an estimated 681 right whales in the eastern and western North Pacific between 1962 and 1968 severely impacted the two populations concerned, notably in the east (Ivashchenko and Clapham 2012, Ivashchenko et al. 2013). Based on sighting data, Wada (1973) estimated a total population of 100-200 in the North Pacific. Rice (1974) stated that only a few individuals remained in the eastern North Pacific stock, and that for all practical purposes the stock was extinct because no sightings of a mature female with a calf had been confirmed since 1900. However, confirmed sightings over the last 14 years, starting in 1996 (Goddard and Rugh 1998), have invalidated this view (Wade et al. 2006). Brownell et al. (2001) suggested from a review of sighting records that the abundance of this species in the western North Pacific was likely in the "low hundreds," including the population in the Ohkotsk Sea.

There were several sightings of North Pacific right whales in the mid-1990s, which renewed interest in conducting dedicated surveys for this species that included the collection of photo-IDs and biopsies. Right whales can be individually identified by photographs of the unique callosity patterns on their heads. In April 1996, a right whale was sighted off Maui (Salden and Mickelsen 1999), and that same animal was identified 119 days later and 4,111 km north (in the Bering Sea); this represents the first high- to low-latitude match of a North Pacific right whale (Kennedy et al. 2011). The ~~April~~ Maui sighting in April was the first documented sighting of a right whale in Hawaiian waters since 1979 (Herman et al. 1980, Rowntree et al. 1980) and, even though the photographic match confirms that Bering Sea animals occasionally travel south, there is ~~no~~little reason to believe that either Hawaii or tropical Mexico have ever been anything except extra-limital habitats for this species (Brownell et al. 2001).

A group of 3-4 right whales, that may have included a juvenile animal, was sighted in western Bristol Bay, southeastern Bering Sea, in July 1996 (Goddard and Rugh 1998). In July 1997, a group of 4-5 individuals was encountered one evening in Bristol Bay, followed by a second sighting of 4-5 whales the following morning in approximately the same location (Tynan 1999). During dedicated surveys in July 1998, July 1999, and July 2000, 5, 6, and 13 right whales~~,~~ were again found in the same general region of the southeastern Bering Sea (LeDuc et al. 2001). Biopsy samples of right whales encountered in the southeastern Bering Sea were taken in 1997 and 1999. Genetic analyses identified three individuals in 1997 and four individuals in 1999; of the animals identified, one was identified in both years, resulting in a total genetic count of six individuals (LeDuc et al. 2001). Genetic analyses of samples from all six whales sampled in 1999 determined that the animals were male (LeDuc et al. 2001). Two right whales were observed during a vessel-based survey in the central Bering Sea in July 1999 (Moore et al. 2000).

During the southeast Bering Sea survey in 2002, there were seven sightings of right whales (LeDuc 2004). One of the sightings in 2002 included a right whale calf; this is the first confirmed sighting of a calf in decades (a possible calf or juvenile sighting was also reported in Goddard and Rugh 1998). This concentration also included two probable calves. In the southeastern Bering Sea during September 2004, multiple right whales were acoustically located and subsequently sighted by another survey vessel approaching a near-real-time position of an individual located with a satellite tag (Wade et al. 2006). An analysis of photographs confirmed at least 17 individual whales (not including the tagged whales). Genetic analysis of biopsy samples identified 17 individuals: 10 males and 7 females. The discovery of ~~7~~seven females was significant as only ~~1~~one female had been identified previously, and at least two calves were present. From 2007 to 2011, 12 individual right whales were seen (some individuals were seen many times over all survey years).

Photographic and genotype data through 2008 were used to calculate the first mark-recapture estimates of abundance for right whales in the Bering Sea and Aleutian Islands, resulting in estimates of 31 (95% CL: 23-54, CV = 0.22) and 28 (95% CL: 24-42), respectively (Wade et al. 2011a). The abundance estimates are for the last year of each study, corresponding to 2008 for the photo-identification estimate~~,~~ and 2004 for the genetic identification estimates. Wade et al. (2011a) also estimate the population consists of ~~eight~~8 females (95% CL: 7-18) and 20 males (95% CL: 17-37). Wade et al. (2011a) summarized the photo-identification and genetic-identification catalogues as follows: twenty-one individuals were identified from genotyping from the Aleutian Islands and Bering Sea from 1997 to 2004, comprising 15 males and 6 females. In aggregate, there were ~~8~~eight photo matches of individual whales across years involving ~~5~~five individuals. Wade et al. (2006) reported 17 individuals (including 7 females) identified from genotyping in 2004; that number was revised to 16 individuals (including 6 females) because a typographical error was subsequently discovered that masked a duplicate sample. There were ~~4~~four biopsies taken in 2008 and 2009 of ~~2~~two males and ~~2~~two females; three of these animals had been sampled in previous years. These samples were only recently processed and ~~did not make it into~~were not included in the Wade et al. (2011a) abundance estimate (A. Kennedy, ~~pers. comm.,~~ NMFS, AFSC, NMML, pers. comm., 21 September 2011).

The photo-identification catalogue, for purposes of abundance estimation, was restricted to aerial or left-side oblique photographs of good or excellent photo quality. After this restriction, there were a total of 18 unique individuals identified from photographs of callosity patterns and scars from 1998 to 2008, with 10 resightings across years involving 5 individuals.

Another ~~7~~seven individuals were observed in the summer of 2009, and one individual was seen in the summer of 2010 (A. Kennedy, NMFS, AFSC,~~-~~ NMML, pers. comm., 3 November 2010). Four individuals were seen in the summer of 2011 (B. Rone, NMFS, AFSC, ~~-~~NMML, pers. comm., 7 October 2012). ~~There were~~The two sightings noted above of right whales (one in June and one in October) in British Columbia waters in 2013~~, one of which was also seen off northern Washington state (J. Ford, Department of Fisheries and Oceans, BC, Canada, pers. comm.); these~~ were the first sightings of this species in this region in decades. Comparisons with the photo-identification catalogue curated at the National Marine Mammal Laboratory showed that neither individual had been previously photographed elsewhere. Whether this indicates that right whales are returning to these coastal waters where they were once hunted is unclear.~~ One of the individuals was a large animal with a major injury on its rostrum, perhaps the result of an earlier entanglement in fishing gear (J. Ford, Department of Fisheries and Oceans, BC, Canada, pers. comm., 28 October 2013).~~

LeDuc et al. (2012) analyzed 49 biopsy samples from right whales identified as being from 24 individuals, of which all but one were from the eastern North Pacific. The analysis revealed a male-biased sex ratio~~,~~ and a loss of genetic diversity that appeared to be midway between that observed for right whales in the North Atlantic and the Southern Hemisphere. The analysis also suggested a degree of separation between eastern and western populations, a male:female ratio of 2:1, and a low effective population size for the eastern North Pacific stock, which LeDuc et al. (2012) considered to be at "extreme risk" of extirpation.

Detections of right whales have been very rare in the Gulf of Alaska, even though large numbers of whales were caught there in the 1800s and 1960s. With the exception of the Soviet catches, primarily in 1963-1964 (Ivashchenko and Clapham 2012), from the 1960s through 2002, only two sightings of right whales occurred in the Gulf of Alaska: an opportunistic sighting in March 1979 near Yakutat Bay in the eastern Gulf (Shelden et al. 2005) and a sighting during an aerial survey for harbor porpoise in July 1998 south of Kodiak Island, Alaska (Waite et al. 2003). Both sightings occurred in shelf waters less than 100 m deep. However, from 2004 to 2006, four sightings of right whales occurred in the Barnabus Trough region on Albatross Bank, south of Kodiak Island, Alaska (Wade et al. 2011b). Sightings of right whales occurred at locations within the trough with the highest density of zooplankton, as measured by active-acoustic backscatter. Photo-identification (of two whales) and genotyping (of one whale) failed to reveal a match to Bering Sea right whales. Fecal hormone metabolite analysis from one whale estimated levels consistent with an immature male, indicating either recent reproduction in the Gulf of Alaska or movements between the Bering Sea and Gulf of Alaska.

In recent decades, the only detections of right whales in pelagic waters of the Gulf of Alaska came from passive acoustic recorders. These detections of calls were exceptionally rare; instruments in seven widespread locations detected right whale calls from only ~~2~~two of the locations on only 6 days out of a total of 80 months of recordings (Mellinger et al. 2004), and on only 5 days out of a total of 70 months of recordings from the ~~5~~five deep-water stations. The calls were heard at the deep-water station in the Gulf of Alaska ~500 km southwest of Kodiak Island on 5 days in August and September of 2000, but no calls were detected from ~~4~~four other instruments deployed in deep water farther east during 2000 and 2001 (Mellinger et al. 2004). Calls classified as "probable" right whales were detected from an instrument deployed on the shelf at the location of the aerial visual detection on Albatross Bank on 6 September 2000 (Waite et al. 2003), but no calls were detected from two instruments deployed at the base of the continental slope off Albatross Bank just northeast of Barnabus Trough (Mellinger et al. 2004, Munger et al. 2008). Twenty sonobuoy deployments in 2004 throughout the Gulf of Alaska resulted in the detection of right whale calls only in Barnabus Trough, near the location of the visual sightings mentioned above (Wade et al. 2011b). Right whale up-calls were detected far offshore in the Gulf of Alaska in 2013 on a bottom-mounted recorder at Quinn Seamount during a total of 3 hours on 2 days (21 June and 3 August 2013). Right whale down calls were detected during 50 hours from 27 July to 5 September 2013 (Sirovic et al. 2014). The lack of detection of right whales from passive acoustic recorders does not provide indisputable evidence there were no right whales in the area, as the whales may not always vocalize or their calls may not always be detected by the automatic algorithms used or the call type targeted for detection. Until very recently, only a single call type, the "up call" was used to automatically detect right whales. The "gunshot" call has recently been identified as another candidate for right whale detections (Stafford et al. 2010). However, it is interesting to note the contrasting data from the southeastern Bering Sea, where similar instruments on the middle shelf (<100 m depth) detected right whale calls on >6 days per month in July-October (Munger et al. 2008), despite a population estimated to be only 31 whales (Wade et al. 2011a). The lack of detections of right whales in pelagic waters of the Gulf of Alaska may still be partially due to a lack of survey and recording effort in those areas, but the lack of calls in passive-acoustic monitoring suggests that right whales are very rare in at least the monitored pelagic ~~waters~~areas today. More extensive coverage of shelf and nearshore waters of the Gulf of Alaska during previous ship and airplane surveys for cetaceans (summarized in Wade et al. 2011b) have not detected right whales other than the single detection near Kodiak Island by Waite et al. (2003). Therefore, the Barnabus Trough/Albatross Bank area represents the only location in the Gulf of Alaska where right whales have been repeatedly detected in the last 4 decades, and those detections add only a minimum of two additional whales (from photo-identification in 2005 and 2006) to the total eastern population. However, there has been virtually no survey coverage of the offshore waters in which right whales commonly occurred during historical and recent whaling periods (Townsend 1935, Ivashchenko and Clapham 2012).

Minimum Population Estimate

The minimum estimate of abundance of North Pacific right whales is 25.7 based on the 20th~~th~~ percentile of the photo-identification estimate of 31 (CV = 0.226; Wade et al. 2011a). The photo-identification catalogue used in the mark-recapture abundance estimate has a minimum of 20 unique individuals seen from 1998 to 2013, yet this number could be higher given that there are many animals with poor quality photos or poor coverage (one side only). The genetic-identification catalogue has a total of 23 individuals identified from 1997 to 2011 (LeDuc et al. 2012).

Current Population Trend

No estimate of trend in abundance is currently available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Due to insufficient information, the default cetacean maximum net productivity rate (R_{MAX}) of 4% is used for this stock (Wade and Angliss 1997). However, given the small apparent size, male bias, and low observed calving rate of this population, this rate ~~may~~is likely to be unrealistically high.

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 0.1, the recommended value for cetacean stocks which are listed as endangered (Wade and Angliss 1997). A reliable estimate of minimum abundance for this stock is 25.7 based on the mark-recapture estimate of 31 (CV = 0.226; Wade et al. 2011a). The calculated PBR level for this stock is therefore 0.05 which would be equivalent to one take every 20 years. ~~Regardless of the PBR level, because this species is listed under the Endangered Species Act and no negligible impact determination has been made, no human-caused takes of this population are authorized; PBR for this stock is 0.~~

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~**New Serious Injury Guidelines**~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Gillnets were implicated in the death of a right whale off the Kamchatka Peninsula (Russia) in October of 1989 (Kornev 1994), which was presumably from the western North Pacific population. No other incidental takes of right whales are known to have occurred in the North Pacific, although one photograph from the catalog shows potential fishing gear entanglement (A. Kennedy, NMFS, AFSC, ~~-~~NMML, pers. comm., 21 September 2011). The right whale photographed on 25 October 2013 off British Columbia and northern Washington ~~s~~State, showed potential fishing gear entanglement (J. Ford, ~~pers. comm.,~~ Department of Fisheries and Oceans, BC, Canada, pers. comm., 28 October 2013). Vessel collisions are considered the primary source of human-caused mortality and serious injury of right whales in the North Atlantic (Cole et al. 2005). Given the very small estimate of abundance, a~~A~~ny mortality or serious injury incidental to commercial fisheries would be considered significant. Entanglement in fishing gear, including lobster pot and sink gillnet gear, is a significant source of mortality and serious injury for the North Atlantic right whale stock (Waring et al. 2004).

There are no records of ~~fisheries mortalities~~mortality or serious injury of eastern North Pacific right whales in any U.S. fishery. Thus, the estimated annual mortality and serious injury rate incidental to U.S. commercial fisheries approaches zero whales per year from this stock. Therefore, the annual human-caused mortality and serious injury level is considered to be insignificant and approaching a zero mortality and serious injury rate.

Alaska Native Subsistence/~~Native~~ Harvest Information

Subsistence hunters in Alaska and Russia are not reported to take animals from this stock.

Other Mortality

Ship strikes are a significant source~~s~~ of mortality and serious injury for the North Atlantic stock of right whales, and it is possible that right whales in the North Pacific are also vulnerable to this source of mortality. However, due to their rare occurrence and scattered distribution it is impossible to assess the threat of ship strikes to the North Pacific stock of right whales at this time. There is concern regarding the effects of increased shipping through ~~the~~ Arctic waters and the Bering Sea with retreating sea ice, which may increase the potential risk to right whales from shipping.

Overall, given the remote nature of the known and likely habitats of North Pacific right whales, it is very unlikely that any mortality in this population would be observed. Consequently, it is possible that the current absence of reported deaths in this stock is not a reflection of the true situation.

STATUS OF STOCK

The right whale is listed as "endangered" under the Endangered Species Act of 1973, and therefore designated as "depleted" under the MMPA. In 2008, NMFS relisted the North Pacific right whale as "endangered" as a separate species (*Eubalaena japonica*) from the North Atlantic species, *E. glacialis* (73 FR 12024, 06 March 2008). As a result, the stock is classified as a strategic stock. The abundance of this stock is considered to represent only a small fraction of its pre-commercial whaling abundance (i.e., the stock is well below its Optimum Sustainable Population ~~size~~). The estimated annual rate of human-caused mortality and serious injury is considered minimal for this stock. The reason(s) for the apparent lack of recovery for this stock is (are) unknown. Brownell et al. (2001) noted the devastating impact of extensive illegal Soviet catches in the eastern North Pacific in the 1960s, and suggested that the prognosis for right whales in this area was "poor." Biologists working aboard the Soviet factory ships which killed right whales in the eastern North Pacific in the 1960s considered that the fleets had caught close to 100% of the animals they encountered (Ivashchenko and Clapham 2012); accordingly, it is quite possible that the Soviets wiped out the great majority of the animals in the population at that time. In its review of the status of right whales worldwide, the International Whaling Commission expressed "considerable concern" over the status of this population (IWC 2001), which is ~~arguably~~currently the most endangered stock of large whales in the world for which an abundance estimate is available.

HABITAT CONCERNS

NMFS conducted an analysis of right whale distribution in historic times and in recent years~~,~~ and stated that principal habitat requirements for right whales are dense concentrations of prey (Clapham et al. 2006), and on this basis proposed two areas of critical habitat: one in the southeastern Bering Sea and another south of Kodiak Island (70 FR 66332, 2 November 2005). In 2006, NMFS issued a final rule designating these two areas as northern right whale critical habitat, one in the Gulf of Alaska and one in the Bering Sea (71 FR 38277, 6 July 2006; Fig. 1). In 2008, NMFS redesignated the same two areas as eastern North Pacific right whale critical habitat under the newly recognized species name, *E. japonica*.

~~There are no known current threats to the habitat of this population, although this partly reflects a lack of information about the current distribution and habitat requirements of right whales in the eastern North Pacific, as well as about the location and nature of any potential threats to the animal or its environment.~~Potential threats to the habitat of this population derive primarily from commercial shipping and fishing vessel activity. There is considerable fishing activity within portions of the critical habitat of this species, increasing the risk of entanglement, although photographs of right whales taken to date have shown no evidence of entanglement scars.

The high volume of large vessels transiting Unimak Pass (e.g., 1,961 making 4,615 transits in 2012 (Nuka Research and Planning Group, LLC 2014a, 2014b), a subset of which continue north through the Bering Sea, increases both the risk of ship strikes and the risk of a large or very large oil spill in areas in which right whales may occur. The risk of accidents in Unimak Pass specifically is predicted to increase in the coming decades, and studies indicate that more accidents are likely to involve container vessels (Wolniakowski et al. 2011) The U.S. Department of the Interior has designated areas within the southeastern Bering Sea, including areas designated as right whale critical habitat, as ~~one of their~~an outer continental shelf oil and gas lease area~~s~~. This planning area, referred to as the North Aleutian Basin, was not included in the current 2012-2017 national lease schedule by the Bureau of Ocean Energy Management, and there are no residual active leases from past sales. On December 16, 2014, President Obama announced that, under authority granted him by Section 12(a) of the Outer Continental Lands Act (OCSLA), he was withdrawing the North Aleutian Basin from future oil and gas leasing, development or production "for a time period without specific expiration." Thus, oil and gas leasing in federal waters in this area is not likely for the foreseeable future. ~~The Mineral Management Service (currently Bureau of Ocean Energy Management) supported a series of surveys from 2007 to 2009 to better understand right whale distribution in this area so that potential impacts and mitigation measures can be better assessed.~~

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BOWHEAD WHALE (*Balaena mysticetus*): Western Arctic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Western Arctic bowhead whales are distributed in seasonally ice-covered waters of the Arctic and near-Arctic, generally north of 60°N and south of 75°N in the western Arctic Basin (Braham 1984, Moore and Reeves 1993). For management purposes, four stocks of bowhead whales have been recognized worldwide by the International Whaling Commission (IWC 2010). ~~Single s~~Small stocks, comprised of only a few tens to a few hundreds of individuals, occur in the Sea of Okhotsk and the offshore waters of Spitsbergen~~, comprised of only a few tens to a few hundreds of individuals~~ (Zeh et al. 1993, Shelden and Rugh 1995, Wiig et al. 2009~~, Zeh et al. 1993~~). Bowheads occur in western Greenland (Hudson Bay and Foxe Basin) and eastern Canada (Baffin Bay and Davis Strait), and recent evidence suggests that these should be considered one stock based on genetics (Postma et al. 2006, Bachmann et al. 2010, Heide-Jørgensen et al. 2010, Wiig et al. 2010~~, Bachmann et al. 2010~~), aerial surveys (Cosens et al. 2006), and tagging data (Dueck et al. 2006; Heide-Jørgensen et al. 2006; IWC 2010, 2011). This stock, previously thought to include only a few hundred animals, may number over a thousand (Heide-Jørgensen et al. 2006, Wiig et al. 2011), and perhaps over 6,000 (IWC 2008). The only stock found within U.S. waters is the Western Arctic stock (Figs. 1 and 2), also known as the Bering-Chukchi-Beaufort stock (Rugh et al. 2003) or Bering Sea stock (Burns et al. 1993). Although Jorde et al. (2007) suggested there might be multiple stocks of bowhead whales in U.S. waters, several studies (George et al. 2007, Taylor et al. 2007, Rugh et al. 2009~~, Taylor et al. 2007~~) and the IWC Scientific Committee concluded that data are most consistent with one stock that migrates throughout waters of northern and western Alaska (IWC 2008).

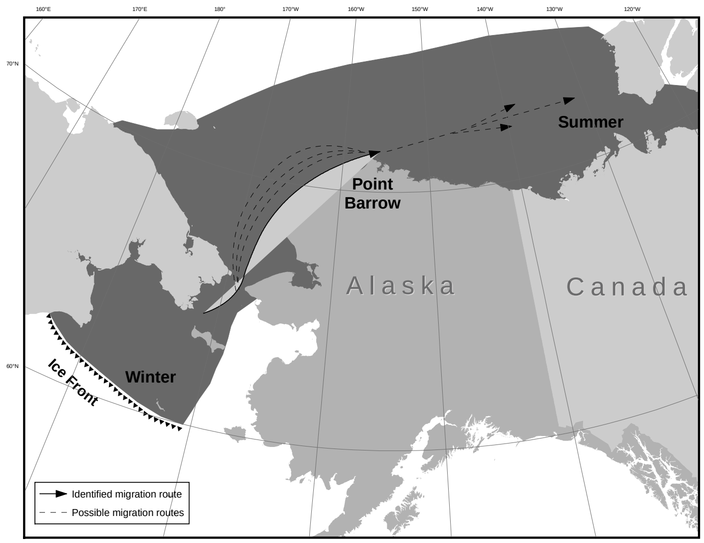

Figure 1. Dark areas depict the approximate distribution of the Western Arctic stock of bowhead whales. The spring migration represented here by lines and arrows follows a route from the Bering Sea wintering area to the Beaufort Sea summering area, mostly along a coastal tangent that constricts somewhat as it goes east past Point Barrow.

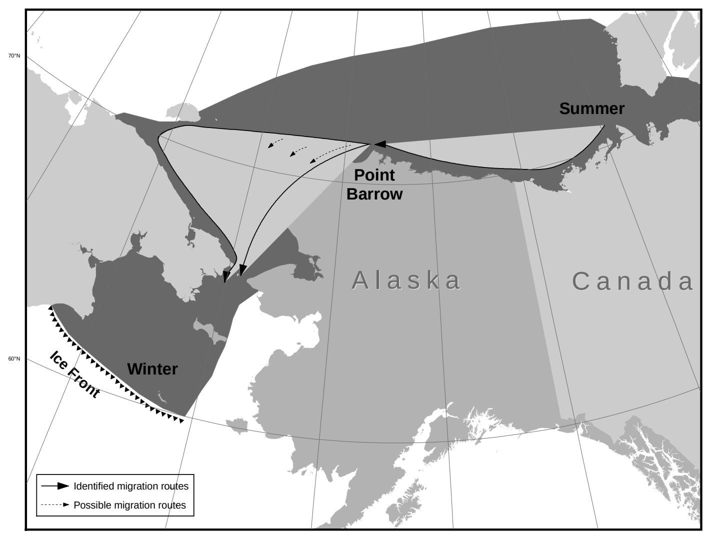

Figure 2. Dark areas depict the approximate distribution of the western Arctic stock of bowhead whales. The fall migration is represented here by lines and arrows showing generalized routes used to travel from the Beaufort Sea (summering area) to the Bering Sea (wintering area).

The majority of the Western Arctic stock migrates annually from wintering areas (December to March) in the northern Bering Sea, through the Chukchi Sea in the spring (April through May), to the eastern Beaufort Sea (Fig. 1) where they spend much of the summer (June through early to mid-October) before returning again to the Bering Sea (Fig. 2) in the fall (September through December) to overwinter (Braham et al. 1980, Moore and Reeves 1993, Quakenbush et al. 2010a). Some bowheads are found in the western Beaufort, Chukchi, and Bering Seas in summer, and these are thought to be a part of the expanding Western Arctic stock (Rugh et al. 2003~~,~~; Clarke et al. 2013~~;~~, 2014).

During winter and spring, bowhead whales are closely associated with sea ice (Moore and Reeves 1993, Quakenbush et al. 2010a). The bowhead spring migration follows fractures in the sea ice around the coast of Alaska, generally in the shear zone between the shorefast ice and the mobile pack ice. During ~~the~~ summer, most of the population is in relatively ice-free waters in the southeastern Beaufort Sea, an area often exposed to industrial activity related to petroleum exploration (e.g., Richardson et al. 1987, Davies 1997). Summer aerial surveys conducted in the western Beaufort Sea during July and August of 2012-2014~~ and 2013~~ have had relatively high sighting rates of bowhead whales, including cows with calves and feeding animals (Clarke et al. 2013, 2014; NMML, unpubl.~~ished~~ data, available ~~at~~online: http://www.afsc.noaa.gov/nmml/cetacean/bwasp/flights_~~2013~~2014.php). During the autumn migration through the Beaufort Sea, bowheads select shelf waters in all but "heavy ice" conditions, when they select slope habitat (Moore 2000). Heavy ice years in the autumn in the Beaufort Sea are becoming less common because of the retreat of Arctic sea ice. In winter in the Bering Sea, bowheads often use areas with ~100% sea-ice cover, even when polynas are available (Quakenbush et al. 2010a).

Evidence suggests that bowhead whales feed on concentrations of zooplankton throughout their range. Likely or confirmed feeding areas include Amundsen Gulf and eastern Canadian Beaufort Sea; central and western U.S. Beaufort Sea; Wrangel Island; and the coast of Chukotka, between Wrangel Island and the Bering Strait (Lowry et al. 2004; Ashjian et al. 2010; Clarke and Ferguson 2010a; Quakenbush et al. 2010a, 2010b; ~~Lowry et al. 2004; Clarke and Ferguson 2010a; Ashjian et al. 2010;~~ Okkonen et al. 2011; Clarke et al. 2012, 2013, 2014; NMML, unpubl.~~ished~~ data, available ~~at~~online: http://www.afsc.noaa.gov/nmml/cetacean/bwasp/flights_~~2013~~2014.php). Bowheads have also been observed feeding during the summer in the northeastern Chukchi Sea (Clarke and Ferguson 2010b).

POPULATION SIZE

All stocks of bowhead whales were severely depleted during intense commercial whaling, starting in the early 16th century near Labrador (Ross 1993) and spreading to the Bering Sea in the mid-19th century (Braham 1984, Bockstoce and Burns 1993, Bockstoce et al. 2007). Woodby and Botkin (1993) summarized previous efforts to estimate ~~how many bowheads there were~~bowhead population size prior to the onset of commercial whaling. They reported a minimum worldwide population estimate of 50,000, with 10,400-23,000 in the Western Arctic stock (dropping to less than 3,000 at the end of commercial whaling). Brandon and Wade (2006) used Bayesian model averaging to estimate that the Western Arctic stock consisted of 10,960 (9,190-13,950; 5th~~th~~ and 95th~~th~~ percentiles, respectively) bowheads in 1848 at the start of commercial whaling.

Since 1978, systematic counts of bowhead whales have been conducted from sites on sea ice near Point Barrow during the whales' spring migration (Krogman et al. 1989). These counts have been corrected for whales missed due to distance offshore (~~through acoustical methods~~ since the mid-1980s, using acoustical methods described in Clark et al. 1994), whales missed when no watch was in effect (through interpolations from sampled periods), and whales missed during a watch (estimated as a function of visibility, number of observers, and distance offshore; Zeh et al.

Table 1. Summary of ~~population~~ abundance estimates for the ~~w~~Western Arctic stock of bowhead whales. The historical estimates were made by back-projecting using a simple recruitment model. All other estimates were developed by corrected ice-based census counts. Historical estimates are from Woodby and Botkin (1993); 1978-2001 estimates are from George et al. (2004) and Zeh and Punt (2004). The 2011 estimate is reported in Givens et al. (2013).

Year	Abundance estimate (CV)	Year	Abundance estimate (CV)
Historical estimate	10,400-23,000	1985	5,762 (0.253)
End of commercial whaling	1,000-3,000	1986	8,917 (0.215)
1978	4,765 (0.305)	1987	5,298 (0.327)
1980	3,885 (0.343)	1988	6,928 (0.120)
1981	4,467 (0.273)	1993	8,167 (0.017)
1982	7,395 (0.281)	2001	10,545 (0.128)
1983	6,573 (0.345)	2011	16,892 (~~0.244~~0.058)

1993). A summary of the resulting abundance estimates is provided in Table 1 and Figure 3. ~~However, t~~These estimates of abundance have not been corrected for a small portion of the population that may not migrate past Point Barrow during the period when counts are made. Attempts to count migrating whales near Point Barrow in 2009 and 2010 were unsuccessful due to sea ice conditions (IWC 2010, George et al. 2011)~~,~~ but were successful in 2011. The ice-based abundance estimate~~,~~ in 2001~~,~~ was 10,545 (CV = 0.128) (updated from George et al. 2004 by Zeh and Punt 2004). The 2011 ice-based abundance estimate was 16,892 (95% CI: ~~15,704~~15,074-18,928) (Givens et al. 2013).

Bowhead whales were identified from aerial photographs taken in 1985 and 1986, and the results were used in a sight-resight analysis. This approach provided estimates of 4,719 (95% CI: 2,382-9,343; SE 1,696) to 7,022 (95% CI: 4,701-12,561; SE 2,017), depending on the model used (daSilva et al. 2000). These population estimates and their associated error ranges are comparable to the estimates obtained from the combined ice-based visual and acoustic data for 1985 (6,039; SE 1,915) and 1986 (7,734; SE 1,450; Raftery and Zeh 1998). Aerial photographs provided another sampling of the bowhead population in 2003 and 2004. Sight-resight results provided estimates of 8,250 whales (95% CI: 3,150-15,450) in 2001 (Schweder et al. 2009) and 12,631 whales (95% CI: 7,900-19,700) in 2004 (Koski et al. 2010), which are consistent with trends in abundance estimates made from ice-based counts. An aerial photographic survey was conducted ~~in~~ near Point Barrow concurrently with the ice-based spring census in 2011; these data are currently being analyzed to produce a revised abundance estimate based on sight-resight data (Mocklin et al. 2012).

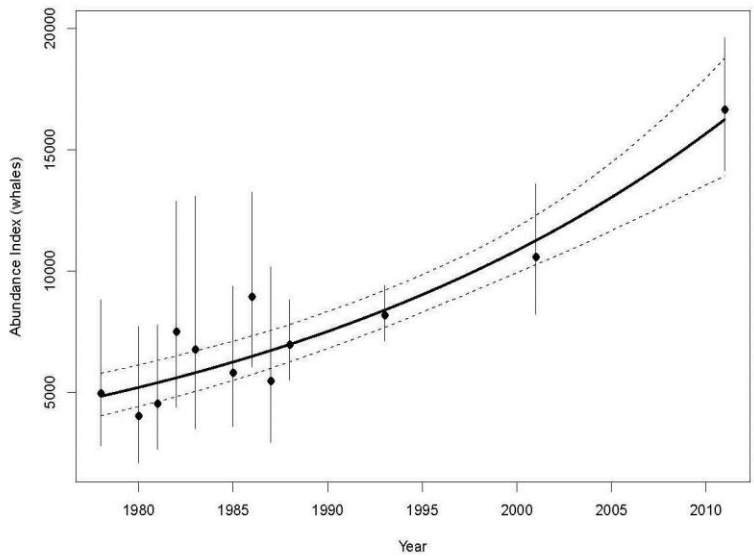

Figure 3. ~~Population a~~Abundance estimates for the W~~w~~estern Arctic stock of bowhead whales, 1978-2011 (Givens et al. 2013), as computed from ice-based counts, acoustic locations, and aerial transect data collected during bowhead whale spring migrations past Barrow, AK.

Minimum Population Estimate

The minimum population estimate (N_{MIN}) for this stock is calculated from Equation 1 from the potential biological removal (PBR) ~~G~~guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the 2011 population estimate (N) of 16,892 and its associated CV(N) of ~~0.244~~0.058, N_{MIN} for the Western Arctic stock of bowhead whales is ~~13,796~~16,091.

Current Population Trend

Based on concurrent passive acoustic and ice-based visual surveys, Givens et al. (2013) reported that the Western Arctic stock of bowhead whales increased at a rate of 3.7% (95% CI = 2.8-4.7%) from 1978 to 2011, during which time abundance tripled from approximately 5,000 to approximately 16,000 whales (Givens et al. 2013). Schweder et al. (2009) estimated the yearly growth rate to be 3.2% (95% CI = 0.5-4.8%) between 1984 and 2003 using a sight-resight analysis of aerial photographs.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The current estimate for the rate of increase for this stock of bowhead whales (3.2-3.7%) should not be used as an estimate of (R_{MAX}) because the population is currently being harvested. It is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be used for the Western Arctic stock of bowhead whales (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the ~~potential biological removal (~~PBR~~)~~ level is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: PBR = $N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock has been set at 0.5 rather than the default value of 0.1 for endangered species because population levels are increasing in the presence of a known take (see ~~guidelines in~~ Wade and Angliss 1997, Pp. 27-28). Thus, PBR = ~~138~~161 animals (~~13,796~~16,091 × 0.02 × 0.5). The calculation of a PBR level for the Western Arctic bowhead stock is required by the MMPA even though the subsistence harvest quota is established under the authority of the IWC based on an extensively tested strike limit algorithm~~s~~ (IWC 2003). The quota is based on subsistence need or the ability of the bowhead population to sustain a harvest, whichever is smaller. The IWC bowhead whale quota takes precedence over the PBR estimate for the purpose of managing the Alaska Native subsistence harvest from this stock. For 2013-2018, the IWC established a block quota of 306 landed bowheads. Because some whales are struck and lost, a strike limit of 67 (plus up to 15 previously unused strikes) could be taken each year. This quota includes an allowance of ~~5~~five animals to be taken by Chukotka Natives in Russia. The 2013-2018 quota maintains the *status quo* of the previous 5-year block quota (2008-2012) but was ~~adjusted~~extended for 6 years.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~New Serious Injury Guidelines~~

~~NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.~~

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/region.htm).

Several cases of rope or net entanglement have been reported from whales taken in the subsistence hunt (Philo et al. 1993). Further, a thorough reexamination of bowhead harvest records is ~~on-going~~ongoing and there are preliminary indications that entanglements or scarring attributed to ropes may include over 20 cases (C. George, Department of Wildlife Management, North Slope Borough, pers. comm.).

There are no observer program records of bowhead whale mortality incidental to U.S. commercial fisheries in Alaska. However, some bowhead whales have historically had interactions with crab pot gear and fishing nets. ~~In 2003 a bowhead whale was found dead in Bristol Bay entangled in line around the peduncle and both flippers; the origin of the line is unknown. In 2004 a bowhead whale near Point Barrow was observed swimming slowly with fishing net and line around the head.~~ One dead whale was found floating in Kotzebue Sound in early July 2010, entangled in crab pot gear similar to that used by commercial crabbers in the Bering Sea (Suydam et al. 2011~~,~~; Table 2). During the 2011 spring aerial photographic survey of bowhead whales near Point Barrow, one entangled bowhead was photographed (Mocklin et al. 2012). The minimum average annual ~~entanglement~~mortality and serious injury rate in U.S. commercial fisheries ~~for the 5-year period from 2008 to 2012~~in 2009-2013 is ~~0.4~~0.2 whales per year; however, the ~~overall~~actual rate is currently unknown.

Table 2. Summary of mortality and serious injury of the Western Arctic stock of bowhead whales, ~~mortalities and serious injuries~~ by year and type, reported to the NMFS Alaska Region~~al Office~~, marine mammal stranding database, ~~for the 2008-2012 period~~in 2009-2013 (~~Allen et al. 2014,~~ Helker et al. 2015). Only cases of serious injury were recorded in this table; animals with non-serious injuries have been excluded.

Cause of ~~I~~injury	**~~2008~~**	**2009**	**2010**	**2011**	**2012**	**2013**	**Mean ~~A~~annual ~~M~~mortality**
Entangled in unspecified pot gear	~~0~~	0	1	0	0	0	~~0.4~~0.2
~~Minimum total annual mortality~~							~~0.40~~

Alaska Native Subsistence/~~Native~~ Harvest Information

Eskimos have been taking bowhead whales for subsistence purposes for at least 2,000 years (Marquette and Bockstoce 1980, Stoker and Krupnik 1993). Subsistence takes have been regulated by a quota system under the authority of the IWC since 1977. Alaska Native subsistence hunters, primarily from 11 Alaska communities, take approximately 0.1-0.5% of the population per annum~~, primarily from eleven Alaska communities~~ (Philo et al. 1993, Suydam et al. 2011). Under this quota, the number of kills in any one year has ranged between 14 and 72~~ per year~~. The maximum number of takes per year is set by the quota, ~~the number depending in part on changes in management strategy, i.e., the quota,~~ which is itself determined~~influenced~~ by the subsistence need and the abundance and trend estimates (Stoker and Krupnik 1993). Suydam and George (2012) summarized Alaskan subsistence harvests of bowheads from 1974 to 2011 and reported a total of 1,149 whales landed by hunters from 12 villages, with Barrow landing the most whales (n = 590) ~~while~~and Shaktoolik land~~ed~~ing only one. Alaska Natives landed ~~38 in 2008 (Suydam et al. 2009),~~ 31 whales in 2009 (Suydam et al. 2010), 45 in 2010 (Suydam et al. 2011), 38 in 2011 (Suydam et al. 2012), ~~and~~ 55 in 2012 (Suydam et al. 2013), and 46 in 2013 (George and Suydam 2014, Suydam et al. 2014). The number of whales landed at each village varies greatly from year to year, as success is influenced by village size and ice and weather conditions. The efficiency of the hunt (the percent of whales struck that are retrieved) has increased since the implementation of the bowhead quota in 1978. In 1978, the efficiency was about 50% and Suydam et al. (~~2013~~2014) reported that the current mean efficiency, from ~~2003 to 2012~~2004 to 2013, is 77%.

Canadian and Russian Natives ~~are~~ also ~~known to~~ take whales from this stock. Hunters from the western Canadian Arctic community of Aklavik harvested one whale in 1991 and one in 1996. No catches for Western Arctic bowheads were reported by either Canadian or Russian hunters for 2006-2007 (IWC 2008, 2009) or by Russia in 2009, 2011, and 2012 (IWC 2011, Ilyashenko 2013), but two bowheads were taken in Russia in 2008 (IWC 2010), ~~and~~two in 2010 (IWC 2012), and one in 2013 (Ilyashenko and Zharikov 2014). The average annual ~~average~~ subsistence take (by Natives of Alaska, Russia, and Canada) during the 5-year period from ~~2008 to 2012~~2009 to 2013 was ~~42~~44 bowhead whales.

Other Mortality

Pelagic commercial whaling for bowheads was conducted from 1849 to 1914 in the Bering, Chukchi, and Beaufort ~~s~~Seas (Bockstoce et al. 2007). During the first two decades of the fishery (1850-1870), over 60% of the estimated pre-whaling ~~abundance~~population was ~~harvested~~killed, and effort remained high into the 20th century (Braham 1984). It is estimated that the pelagic whaling industry harvested 18,684 whales from this stock (Woodby and Botkin 1993). During 1848-1919, shore-based whaling operations (including landings as well as struck and lost estimates from the U.S., Canada, and Russia) took an additional 1,527 animals (Woodby and Botkin 1993). An unknown percentage of the animals taken by the shore-based operations were harvested for subsistence and not commercial purposes. Estimates of mortality likely underestimate the actual harvest as a result of under-reporting of the Soviet catches (Yablokov 1994) and incomplete reporting of struck and lost animals.

Transient killer whales are the only known predators of bowhead whales. In a study of marks on bowheads taken in the subsistence harvest, 4.1% to 7.9% had scars indicating that they had survived attacks by killer whales (George et al. 1994).

With increasing ship traffic and oil and gas activities in the Chukchi and Beaufort Seas, bowheads may become increasingly at-risk from ship strikes.

STATUS OF STOCK

Based on currently available data, the estimated annual mortality rate incidental to U.S. commercial fisheries (~~0.4~~0.2) is not known to exceed 10% of the PBR (~~13.8~~16.1)~~,~~ and, therefore, can be considered to be insignificant. The average annual level of human-caused mortality and serious injury (~~42~~44) is not known to exceed the PBR (~~138~~161) nor the IWC annual maximum strike limit (67). The Western Arctic bowhead whale stock has been increasing in recent years; the estimate of 16,892 from 2011 is between 31% and 170% of the pre-exploitation abundance (estimates ranging roughly from 10,000 to 55,000), and this stock may now be approaching its carrying capacity (Brandon and Wade 2004, 2006). However, the stock is classified as a strategic stock because the bowhead whale is listed as "endangered" under the U.S. Endangered Species Act (ESA) and is therefore also designated as "depleted" under the MMPA.~~ An ESA recovery plan has not been prepared for bowhead whales because: 1) only the Western Arctic stock occurs in U.S. waters and, therefore, a U.S. recovery plan for other stocks would not be appropriate; 2) all stocks are managed under the international authority of the IWC (of which the United States is a member); 3) cooperative agreements already exist between NOAA and the AEWC for purposes of protecting the bowhead whale and the Eskimo culture, promoting scientific investigations, and effectuating the other purpose of the MMPA, the Whaling Convention Act, and the ESA as these acts relate to aboriginal subsistence whaling; and, 4) a recovery plan is not needed to direct research and management necessary to promote the recovery of this stock. NMFS will use criteria developed for the recovery of large whales in general (Angliss et al. 2002) and bowhead whales in particular (Shelden et al. 2001) in the next 5-year ESA status review to determine if a change in listing status is needed (Gerber et al. 2007).~~

~~Habitat Issues~~HABITAT CONCERNS

~~There has been an increase in v~~Vessel traffic in arctic waters is increasing, largely due to~~both with~~ an increase ~~of~~in oil and gas activities ~~as well as~~and commercial shipping~~, in Arctic waters~~. This increase in vessel ~~presence~~traffic could result in an increased number of vessel collisions with bowhead whales (Huntington et al. 2015).

Increasing oil and gas development in the Arctic has led to an increased risk of various forms of pollution in bowhead whale habitat, including oil spills and other pollutants. Also of concern is ~~N~~noise produced by the increased number of seismic surveys and increased vessel traffic resulting from shipping and offshore energy exploration, development, and production operations~~ and shipping are also of concern~~. Evidence indicates that bowhead whales are sensitive to noise from offshore drilling platforms and seismic survey operations (Richardson and Malme 1993, Richardson 1995, Davies 1997)~~,~~ and that the presence of an active drill rig (Schick and Urban 2000) or seismic operations (Miller et al. 1999) may cause bowhead whales to ~~deflect away from~~avoid the activity. Studies in the 1980s indicated that bowheads reacting to seismic activity appeared to recover from ~~these~~ behavioral changes within 30-60 minutes following the end of ~~seismic~~the activity (Richardson et al. 1986, Ljungblad et al. 1988). ~~Although~~However, more recent monitoring studies of 3-D seismic exploration in the nearshore Beaufort Sea during 1996-1998 demonstrated that nearly all fall-~~-~~migrating bowhead whales ~~will~~ avoided an area within 20 km of an active seismic source (Richardson et al. 1999). Furthermore, the studies also~~ and~~ suggested that the bowhead whales' offshore displacement may have begun roughly 35 km (19 n~~.~~–mi~~.~~ or 22 statute miles ~~[~~(st~~.~~ mi~~.]~~)) east of the activity and may have persisted more than 30 km to the west (Richardson et al. 1999). Richardson et al. (1986) observed that feeding bowheads started to turn away from a 30-airgun array with a source level of 248 dB re 1 μPa at a distance of 7.5 km (4.7 mi~~.~~) and ~~swim~~swam away when the vessel was within about 2 km (1.2 mi~~.~~); other whales in the area continued feeding until the seismic vessel was within 3 km (1.9 mi~~.~~). More recent studies have similarly shown ~~greater tolerance of~~that feeding bowhead whales ~~to~~had a greater tolerance of higher sound levels than did migrating whales (Miller et al. 2005, Harris et al. 2007). Data from an aerial monitoring program in the Alaskan Beaufort Sea during 2006-2008 also indicated that bowheads feeding during late summer and autumn did not exhibit large-scale distribution changes in relation to seismic operations (Funk et al. 2010). This apparent tolerance, however, should not be interpreted to mean that bowheads are unaffected by the noise. Feeding bowheads may be so highly motivated to stay in a productive feeding area that they remain in an area with noise levels that could cause adverse physiological effects. They could be experiencing increased stress by staying in a location with very loud noise (MMS 2008).

Another concern for bowhead whales and other arctic species is climate change~~ in the Arctic~~, which is affecting high northern latitudes more than elsewhere. Climate projections for the next 50–100 years, produced by global climate models, consistently show a pronounced warming over the Arctic, accelerated sea-ice loss, and continued permafrost degradation (IPCC 2007, USGS 2011, Jeffries et al. 2014). Within the Arctic, some of the largest changes are expected to occur in the Bering, Beaufort, and Chukchi ~~s~~Seas (Chapman and Walsh 2007, Walsh 2008). Ice-associated animals, such as the bowhead whale, may be sensitive to changes in Arctic weather, sea-surface temperatures, or sea-~~-~~ice extent, and the concomitant effect on prey availability. Laidre et al. (2008) concluded that on a worldwide basis, bowhead whales were likely to be moderately sensitive to climate change based on an analysis of various life history features that could be affected by climate. Currently, there are insufficient data to make reliable predictions of the effects of Arctic climate change on bowhead whales. ~~A study reported in~~ George et al. (2006) showed that landed bowheads had better body condition during years of light ice cover. This, together with high calf production in recent years, suggests that the stock is presently tolerating ~~the~~ recent trends in declining seasonal sea-ice~~-retreat, at least at present~~ coverage, volume, and duration.

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Appendix 1. Summary of changes to the ~~2014~~2015 stock assessments. An 'X' indicates sections where the information presented has been updated since the ~~2013~~2014 stock assessments were released (last revised ~~10/09/2014~~9/8/2015).

Stock	Stock definition	Population size	PBR	Fishery mortality	Subsistence mortality	Status
Steller sea lion (~~w~~Western U.S.)	X	X	X	X	X	X
Steller sea lion (~~e~~Eastern U.S.)	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
Northern fur seal	X	~~X~~	~~X~~	X	X	X
Harbor seal (Aleutian Islands)	X	X	X	X		X
Harbor seal (Pribilof Islands)	X	X		X		X
Harbor seal (Bristol Bay)	X	X	X	X		X
Harbor seal (N. Kodiak)	X	X	X	X	X	X
Harbor seal (S. Kodiak)	X	X	X	X	X	X
Harbor seal (Prince William Sound)	X	X	X	X	X	X
Harbor seal (Cook Inlet/Shelikof Strait)	X	X	X	X		X
Harbor seal (Glacier Bay/Icy Strait)	X	X	X	X	X	X
Harbor seal (Lynn Canal/Stephens Passage)	X	X	X	X	X	X
Harbor seal (Sitka/Chatham Strait)	X	X	X	X	X	X
Harbor seal (Dixon/Cape Decision)	X	X	X	X	X	X
Harbor seal (Clarence Strait)	X	X	X	X	X	X
Spotted seal	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
Bearded seal	X	X	X	X	X	X
Ringed seal	X	~~X~~		X	X	X
Ribbon seal	X	X	X	X	X	X
Beluga whale (Beaufort Sea)	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~
Beluga whale (Eastern~~.~~ Chukchi Sea)	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~
Beluga whale (Eastern~~.~~ Bering Sea)	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
Beluga whale (Bristol Bay)	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
Beluga whale (Cook Inlet)	X	X		X	X	X
Narwhal						
Killer whale (Alaska Resident)						
Killer whale (Northern Resident)						
Killer whale (Gulf of Alaska, Aleutian Islands, Bering Sea Transient)						
Killer whale (AT1 Transient)	X	X		X		X
Killer whale (West Coast Transient)						
Pacific white-sided dolphin	X			X		
Harbor porpoise (S~~E~~outheast Alaska)	X	X	X	X		X
Harbor porpoise (Gulf ~~O~~of Alaska)	X			X	X	X
Harbor porpoise (Bering Sea)	X	X		X	X	X
Dall's porpoise	X	X	X	X		X
Sperm whale	X	X		X		
Baird's beaked whale						
Cuvier's beaked whale						
Stejneger's beaked whale						
Humpback whale (~~w~~Western North Pacific)	X	X	X	X		X
Humpback whale (~~c~~Central North Pacific)	X	X	X	X		X
Fin whale	X	~~X~~		X		~~X~~
Minke whale	X	X		X		
North Pacific right whale	X	X	X	X		
Bowhead whale	X	X	X	X	X	X

Appendix 2. Stock summary table (last revised ~~10/09/2014~~9/8/2015). Stock assessment reports for those stocks in boldface were updated in the ~~2014~~2015 draft stock assessments. N/A indicates data are unknown. UNDET (undetermined) PBR indicates data are available to calculate a PBR level but a determination has been made that calculating a PBR level using those data is inappropriate (see stock assessment for details).

Species	Stock	~~N (est)~~ NEST	CV	~~N(min)~~ NMIN	~~Years since last survey/y~~Year of last survey	~~Rmax~~ RMAX	~~F(r)~~ FR	PBR	Commer. ~~F~~fishery mort.	Native ~~S~~subsist. mort.	Total mort.	Status
Steller sea lion	**Western~~.~~ U.S.**	**~~55,422~~ 49,497**		**~~48,676~~ 49,497**	**~~1/2013~~2014**	**0.12**	**0.1~~0~~**	**~~292~~ 297**	**~~31.5~~ 31**	**199**	**~~238~~ 233**	**S**
Steller sea lion	Eastern~~.~~ U.S.	60,131- 74,448		36,551	~~1/~~2013	0.12	0.75	1,645	51.6~~[4]~~[a]	11.3	92.3	S
Northern fur seal	**Eastern~~. North~~ Pacific**	**648,534**	**~~N/A~~ 0.2**	**548,919**	**~~2/~~2012**	**0.086**	**0.5~~0~~**	**11,802**	**~~1.7~~ 1.1**	**~~461~~ 432**	**~~468~~ 439**	**S**
Harbor seal	**Aleutian Islands**	**~~3,579~~ 6,431**		**~~3,313~~ 5,772**	**~~7/2004~~ 2011**	**0.12**	**0.5~~0~~**	**~~99~~ 173**	**~~1.0~~ 0**	**90**	**~~93.1~~ 90**	**NS**
Harbor seal	**Pribilof Islands**	**232**		**232**	**~~1/~~2010**	**0.12**	**0.5~~0~~**	**7**	**~~1.0~~ 0**	**0**	**~~3.1~~ 0**	**NS**
Harbor seal	**Bristol Bay**	**~~18,577~~ 32,350**		**~~17,690~~ 28,146**	**~~6/2005~~ 2011**	**0.12**	**~~1.0~~ 0.7**	**~~1,061~~ 1,182**	**~~1.0~~ 0.6**	**141**	**~~144.1~~ 142**	**NS**
Harbor seal	**North Kodiak**	**~~4,509~~ 8,321**		**~~4,272~~ 7,096**	**~~5/2006~~ 2011**	**0.12**	**~~1.0~~ 0.7**	**~~256~~ 298**	**~~1.0~~ 0**	**~~131~~ 37**	**~~134.1~~ 37**	**NS**
Harbor seal	**South Kodiak**	**~~11,117~~ 19,199**		**~~10,645~~ 17,479**	**~~5/2006~~ 2011**	**0.12**	**~~1.0~~ 0.3**	**~~639~~ 314**	**~~1.0~~ 1.9**	**~~78~~ 126**	**~~81.1~~ 128**	**NS**
Harbor seal	**Prince William Sound**	**~~31,503~~ 29,889**		**~~27,157~~ 27,936**	**~~5/2006~~ 2011**	**0.12**	**0.5**	**~~815~~ 838**	**~~25.0~~ 24**	**~~439~~ 255**	**~~466.1~~ 279**	**NS**
Harbor seal	**Cook Inlet/Shelikof Strait**	**~~22,900~~ 27,386**		**~~21,896~~ 25,651**	**~~5/2006~~ 2011**	**0.12**	**~~1.0~~ 0.5**	**~~1,314~~ 770**	**~~1.0~~ 0.4**	**233**	**~~236.1~~ 234**	**NS**
Harbor seal	**Glacier Bay/Icy Strait**	**~~5,042~~ 7,210**		**~~4,735~~ 5,647**	**~~4/2007~~2011**	**0.12**	**0.5**	**~~142~~ 169**	**~~1.0~~ 0**	**~~52~~ 104**	**~~55.1~~ 104**	**NS**
Harbor seal	**Lynn Canal/Stephens Passage**	**~~8,870~~ 9,478**		**~~8,481~~ 8,605**	**~~4/2007~~2011**	**0.12**	**~~0.5~~ 0.3**	**~~254~~ 155**	**~~1.0~~ 0**	**~~30~~ 50**	**~~33.1~~ 50**	**NS**
Harbor seal	**Sitka/Chatham Strait**	**~~8,586~~ 14,855**		**~~8,222~~ 13,212**	**~~4/2007~~2011**	**0.12**	**~~0.5~~ 0.7**	**~~247~~ 555**	**~~1.0~~ 0**	**~~222~~ 77**	**~~225.1~~ 77**	**NS**
Harbor seal	**Dixon/Cape Decision**	**~~14,388~~ 18,105**		**~~13,682~~ 16,727**	**~~5/2003~~ 2011**	**0.12**	**~~1.0~~ 0.7**	**~~821~~ 703**	**~~1.0~~ 0**	**~~157~~ 69**	**~~160.1~~ 69**	**NS**

Species	Stock	~~N (est)~~ NEST	CV	~~N(min)~~ NMIN	~~Years since last survey/y~~Year of last survey	~~Rmax~~ RMAX	~~F(r)~~ FR	PBR	Commer. ~~F~~fishery mort.	Native ~~S~~subsist. mort.	Total mort.	Status
Harbor seal	**Clarence Strait**	~~**23,289**~~ **31,634**		~~**22,471**~~ **29,093**	~~**5/2003**~~ **2011**	**0.12**	~~**1.0**~~ **0.7**	~~**1,348**~~ **1,222**	~~**1.0**~~ **0**	~~**164**~~ **40**	~~**167.1**~~ **41**	**NS**
Spotted seal	Alaska	460,268		391,000	~~2/~~2012	0.12	0.5~~0~~	11,730	1.5	5,265	5,267	NS
Bearded seal	**Alaska**	**N/A**		**N/A**	**2013**	**0.12**	**0.5~~0~~**	**N/A**	~~**1.8**~~ **1.2**	**6,788**	~~**6,790**~~ **6,789**	**S**
Ringed seal	**Alaska**	**N/A**		**N/A**	**2013**	**0.12**	**0.5~~0~~**	~~**N/A**~~ **UNDET**	**4.1**	~~**9,567**~~ **1,040**	~~**9,571**~~ **1,044**	**S**
Ribbon seal	**Alaska**	~~**61,100 (provisional)**~~ **184,000**		~~**N/A**~~ **163,086**	~~**2/2012**~~ **2013**	**0.12**	~~**0.50**~~ **1.0**	~~**N/A**~~ **9,785**	~~**1.02**~~ **0.6**	~~**193**~~ **3.2**	~~**194**~~ **3.8**	**NS**
Beluga whale	Beaufort Sea	39,258	0.23	32,453	~~22/~~1992	0.04	1.0~~0~~	649	0	166	166	NS
Beluga whale	Eastern~~.~~ Chukchi Sea	3,710	N/A	UNK	~~23/~~1991	0.04	1.0~~0~~	UNDET	0	57.4	57.4	NS
Beluga whale	Eastern~~.~~ Bering Sea	19,186	0.32	UNK	~~14/~~2000	0.04	1.0~~0~~	UNDET	0	181	181	NS
Beluga whale	Bristol Bay	2,877	0.2	2,467	~~9/~~2005	0.048	1.0~~0~~	59	0.2	24	24.2	NS
Beluga whale	**Cook Inlet**	**312**	~~**0.13**~~ **0.10**	**280**	~~**2/2012**~~ **2014**	**0.04**	**0.1**	**UNDET**	**0**	**0**	~~**0**~~ **0.2**	**S**
Narwhal	Unidentified ~~stock~~	N/A		N/A		0.04	0.5~~0~~	N/A	0	0	0	NS
Killer whale	Eastern North Pacific Alaska Resident	2,347[~~3~~b]	N/A	2,347	~~1/~~2012	0.04	0.5~~0~~	23.4	0.9	0	0.9	NS
Killer whale	Eastern North Pacific Northern Resident (British Columbia)	261[~~3~~b]	N/A	261	~~2/~~2011	0.03	0.5	1.96	0	0	0	NS
Killer whale	Eastern North Pacific ~~GOA~~Gulf of Alaska, ~~AI~~Aleutian Islands, Bering Sea Transient	587[~~3~~b]	N/A	587	~~1/~~2012	0.04	0.5	5.9	0.6	0	0.6	NS
Killer whale	**AT1 ~~t~~Transient**	**7**[~~3~~b]	**N/A**	**7**	~~**1/2013**~~ **2014**	**0.04**	**0.1~~0~~**	**0**	**0**	**0**	**0**	**S**
Killer whale	West Coast Transient	243[~~3~~b]	N/A	243	~~3/~~2009	0.04	0.5	2.4	0	0	0	NS

Species	Stock	~~N (est)~~ NEST	CV	~~N(min)~~ NMIN	~~Years since last survey/y~~Year of last survey	~~Rmax~~ RMAX	~~F(r)~~ FR	PBR	Commer. ~~F~~fishery mort.	Native ~~S~~subsist. mort.	Total mort.	Status
Pacific white-sided dolphin	~~Cent.~~ North~~.~~ Pacific	26,880	N/A	N/A	~~12+~~/1990	0.04	0.5~~0~~	UNDET	0	0	0	NS
Harbor porpoise	S~~E~~outheast Alaska	11,146	0.242	~~9,116~~ N/A	~~17/~~1997	0.04	0.5~~0~~	UNDET	~~22.6[1]~~ 34	0	~~22.6[1]~~ 34	S
Harbor porpoise	Gulf of Alaska	31,046	0.214	~~25,987~~ N/A	~~16/~~1998	0.04	0.5~~0~~	UNDET	~~71.4~~ 72	0	~~71.4~~ 72	S
Harbor porpoise	Bering Sea	48,215	0.223	~~40,039~~ N/A	~~15/~~1999	0.04	0.5~~0~~	UNDET	0.2	0	~~0.2~~ 0.4	S
Dall's porpoise	Alaska	83,400	0.097	N/A	~~18/~~1993	0.04	1.0~~0~~	UNDET	~~28.9~~ 38	0	~~28.9~~ 38	NS
Sperm whale	North~~.~~ Pacific	N/A		N/A		0.04	0.1~~0~~	N/A	~~0~~ 0.8	0	~~0~~ 0.8	S
Baird's beaked whale	Alaska	N/A		N/A		0.04	0.5~~0~~	N/A	0	0	0	NS
Cuvier's beaked whale	Alaska	N/A		N/A		0.04	0.5~~0~~	N/A	0	0	0	NS
Stejneger's beaked whale	Alaska	N/A		N/A		0.04	0.5~~0~~	N/A	0	0	0	NS
Humpback whale	Western~~.~~ North~~.~~ Pacific	~~1,107~~ 893	~~0.30~~ 0.079	~~865~~ 836	~~8/~~2006	0.07	0.1~~0~~	~~3.0~~ 2.9	~~0.9[4]~~ 0.8	0	~~2.15[4]~~ 2.2	S
Humpback whale	Central North Pacific - entire stock	~~10,103~~ 10,252	~~0.30~~ 0.042	~~7,890~~ 9,896	~~8/~~2006	0.07	~~0.3~~ 0.5	~~82.8~~ 173	~~8.4[4]~~ 7.3	0	~~15.89[4]~~ 23	S
Fin whale	~~NE~~Northeast Pacific	N/A	N/A	N/A	~~4/~~2010	0.04	0.1~~0~~	UNDET	0.2	0	0.6	S
Minke whale	Alaska	N/A		N/A		0.04	0.5~~0~~	N/A	0	0	~~0.2~~ 0	NS
North Pacific ~~R~~right whale	Eastern~~.~~ North~~.~~ Pacific	31	~~0.23~~ 0.226	25.7	~~4/2010~~ 2013	0.04	0.1~~0~~	~~0~~ 0.05	0	0	0	S
Bowhead whale	Western~~.~~ Arctic	16,892	~~0.24~~ 0.058	~~13,796~~ 16,091	~~3/~~2011	0.04	0.5~~0~~	~~138~~ 161	~~0.4~~ 0.2	~~42~~ 44	~~42.4~~ 44	S

C.F. = correction factor; CV C.F. = CV of correction factor; Comb. CV = combined CV; Status: S = Strategic, NS = Not Strategic.

~~[1] No or minimal reported take by fishery observers; however, observer coverage was minimal or nonexistent.~~

~~[2] Recent changes in the abundance estimates do not indicate a major population increase. Instead, these increases are due to new analytical methods that take environmental covariates into account and thus provide an improved estimate of harbor seal abundance.~~

~~[3] N(est) based on counts of individual animals identified from photo-identification catalogs. Surveys for abundance estimates of these stocks are conducted infrequently.~~

~~[4] Includes entanglements from recreational or subsistence fisheries.~~

~~[5] Mortality and serious injury estimates calculated for humpbacks in the northern area of the Central North Pacific humpback whale stock range (Gulf of Alaska, Aleutian Islands, and Bering Sea).~~

[a]Includes entanglements from recreational or subsistence fisheries.

[b]N(est) based on counts of individual animals identified from photo-identification catalogs. Surveys for abundance estimates of these stocks are conducted infrequently.